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PURCHASING AGENT'S INDEX

OF MATTHEWS PATENTED MONEY-SAVING SPECIALTIES WHERE ALL NECESSARY DATA
FOR ORDERING MAY BE FOUND

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W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



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MATTHEWS CATALOG AND HAND BOOK NUMBER NINE

PRICE POST PAID ONE DOLLAR

COMPILED BY

CLAUDE LEVERING MATTHEWS

MEMBER AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
MEMBER PRINCETON ENGINEERING ASSOCIATION

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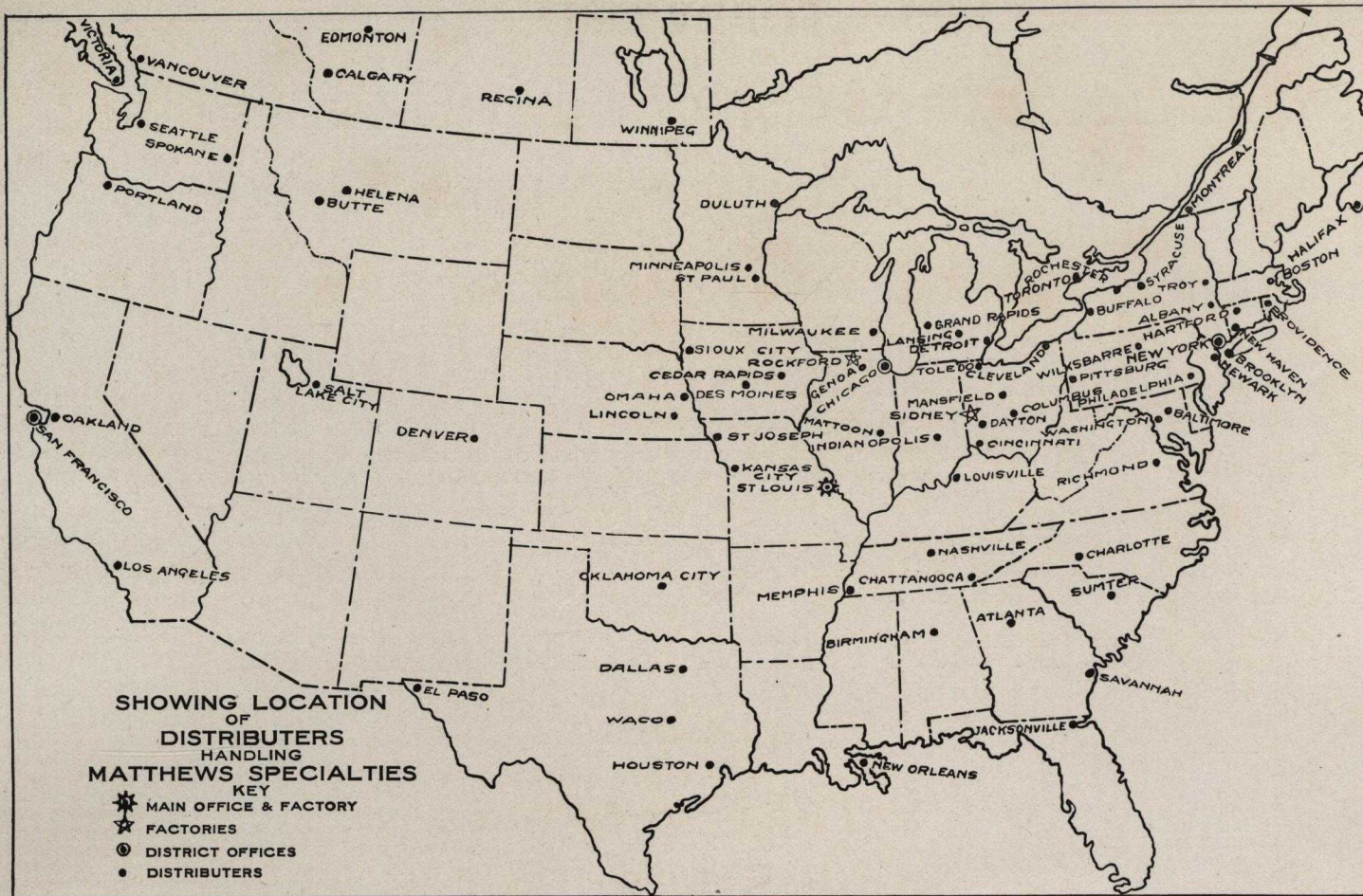
FOR

W. N. MATTHEWS & BROTHER, Inc.

ST. LOUIS
U. S. A.

ESTABLISHED 1899
INCORPORATED 1914

AUGUST FIRST
1914



FOREWORD

THE sale of Matthews' Patented Money Saving Specialties has increased every year by percentages that are truly surprising. The oldest Matthews' Specialty (Matthews' Guy Anchor) has never had a year in the fifteen years it has headed the line that its sales have not greatly exceeded those of the previous year.

The following are the new Matthews' Money Saving Specialties that have been added to the line since the publication of Matthews' Catalog 8, in May, 1912:

Matthews' Teleheights. See pages 28 and 29.

Matthews' Type B. Telefault. See pages 26 and 27.

Matthews' Type C. Telefault. See pages 24 and 25.

Matthews' Deadendeyes. See pages 14 and 15.

Matthews' Prisectioms. See pages 38 and 39.

Matthews' Number 4 Easy Lamp Changer. See pages 34 and 35.

Matthews' 714 and 814 Holdfast Lamp Guards. See page 33.

Matthews' Type F Fuse Switch. See page 17.

Matthews' Scale Knockers. See page 37.

In addition to the above many improvements have been added to the older specialties.

We are still interested in adding new patented inventions to the Matthews' Line, and will be glad to correspond with anyone who either has a patent or who wants us to furnish money to obtain one. If you have a device which you think is sufficiently good to entitle it to addition to the Matthews' Line, write us about it. We purchase patents outright or manufacture and sell patented inventions on a royalty basis. **SEE \$25.00 PRIZE PROPOSITION ON PAGE 208, YOU MAY WIN IT.**

We want every one who is interested in Matthews' Money Saving Specialties to have a copy of this Catalog and Hand Book. The number printed is necessarily limited, and because of this fact and because we believe it is worth it, a charge of \$1.00 will be made for duplicate copies. Please send stamps, cash or post office or express money order.

We wish to thank all of those who have helped us to build the largest business of its kind in the world, and hope that we may deserve the help of many more in the future, so that we may always retain this position.

W. N. MATTHEWS & BROTHER, INC.

ST LOUIS
FOURTH CITY



SOME SAY:

"Matthews Does While Others Buzz"



OUR POLICY

1. To succeed because we merit success.
2. To be the best and remain the largest business of the kind in the world.
3. To maintain our reputation for breadth and liberality, and at the same time continue to be aggressive in our policy and methods.
4. To strive constantly for the improvement and advancement of the business, and therefore of ourselves.
5. To be loyal to the company as well as to each other.
6. To foster good fellowship among ourselves and to make our work a pleasure as well as a means of livelihood.
7. To sell nothing we can't guarantee.
8. To be considerate and courteous in all our dealings within and without the business.
9. To be high-toned in everything everywhere.
10. To take a pride in our institution, of which we are all a part.

W. N. Matthews & Brother, Inc.

ST. LOUIS, U. S. A.

FACTORIES

AT SIDNEY, OHIO
AT ROCKFORD, ILLINOIS
AT ST. LOUIS, U. S. A.

OFFICES

IN NEW YORK
Hudson Terminal Bldg., 30 Church
Street

IN CHICAGO
507 South Clinton Street

IN SAN FRANCISCO
629 Howard Street



OTHERS SAY:

"Competition Wavers Before Matthews Savers"



TRIAL ORDER PROPOSITIONS ON MATTHEWS PATENTED MONEY-SAVING SPECIALTIES

No. 1. Any number of Matthews' Guy Anchors will be shipped on thirty days' free trial. If your first order calls for twelve or more Anchors and one Wrench we will pay the freight charges. See addition below.

No. 2. Any number of Matthews' Cable Clamps will be shipped on thirty days' free trial. If your first order calls for twenty-five or more we will pay the freight charges. See addition below.

No. 3. Any number of Matthews' Boltless Guy Clamps will be shipped on thirty days' free trial. If your first order calls for 100 or more we will pay the freight charges. See addition below.

No. 4. Any number of Matthews' 2-Bolt Guy Clamps will be shipped on thirty days' free trial. If your first order calls for 100 or more 2-Bolt Guy Clamps and one Chain Lever we will pay the freight charges. See addition below.

No. 5. Any number of Matthews' Fuse Switches will be shipped on thirty days' free trial. If your first order calls for twelve or more Fuse Switches we will pay the freight charges. See addition below.

No. 6. Any number of Matthews' Cable Splicing Joints will be shipped on thirty days' free trial. See addition below.

No. 7. A Matthews' Teleheight, Telefault, Telepipe or Scale Knocker will be shipped on ten days' free trial. Always shipped by express unless otherwise ordered.

No. 8. Twelve Matthews' Prisectiions will be sent by freight on thirty days' trial. If their installed cost is half of the installed cost of wood arm construction pay for them. Trial period thirty days.

ADDITION TO ALL OF THE ABOVE TRIAL PROPOSITIONS

If the Specialties ordered on trial prove satisfactory within the specified time, you are to pay for them promptly. If they do not, write us for shipping instructions and receive cancellation of our bill when goods are received by us.

A free sample Matthews' Cable Hanger will be sent upon request.

Carrying charges will not be paid to the buyer on the Specialties mentioned in Nos. 6 and 7.

The above trial propositions do not apply outside of the United States of America.

They may be made by any Jobber having a selling agreement with us.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

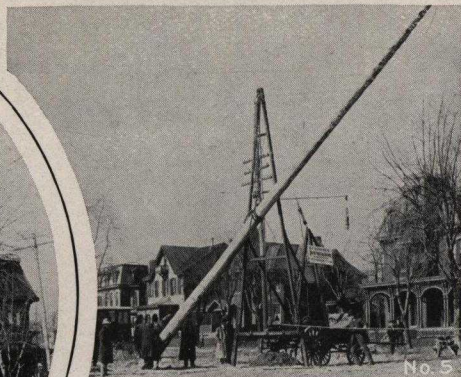




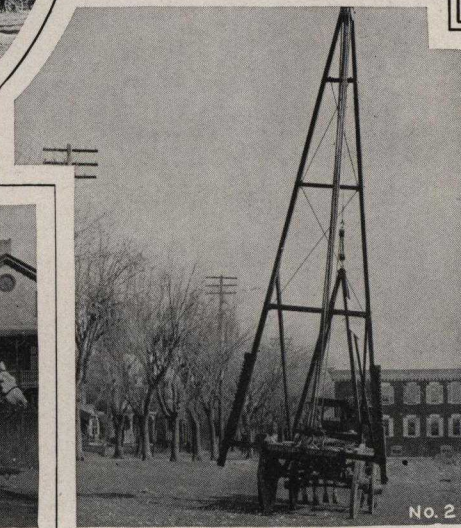
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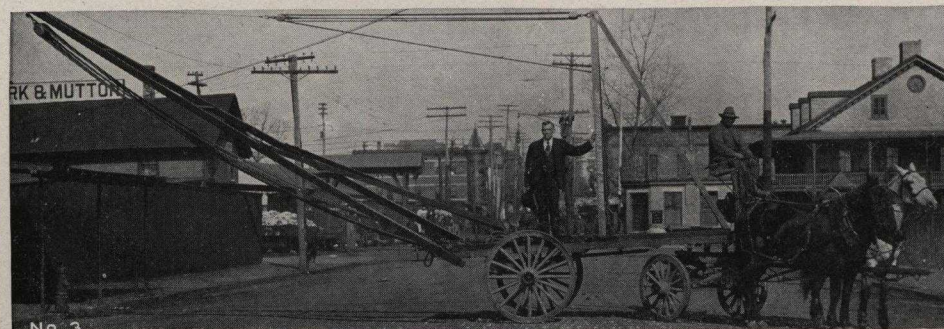
No. 4



No. 5



No. 2



No. 3

MATTHEWS POLERECTOR

Invented by Benj. F. Shafer—Patent Number 873799

It is believed that every pole-using company will welcome the Matthews' Polerector, as it solves the problem of placing poles in their upright position in an economical manner. Matthews' Polerector is the result of thirty-five years' experience in the handling of poles and of ten years' of study and experiment toward the production of a machine that would minimize the great expense of placing them in their holes ready for tamping.

Companies that have to remove poles on account of going underground will find that Matthews' Polerector can be used to take down poles with great economy.

A glance at the photographs on opposite page and on page 50 will give the reader a good idea of the use and advantages of the Matthews' Polerector. No. 1 shows the apparatus mounted on an ordinary truck and gives a good idea of the detail of the machine. No. 2 shows a rear view with adjustable legs raised clear of ground. No. 3 shows the way the mast or derrick can be lowered, so that it will pass under aerial obstructions. No. 4 shows the Polerector in place ready to raise a 51-foot chestnut pole. No. 5 shows the pole in mid-air just before it assumes its perpendicular position. The location of the Polerector in Nos. 4 and 5 was 135 feet from that shown in No. 1, and it required just 6 minues to put this 2,000-pound pole in its hole after the wagon left its starting place. Two linemen and a laborer to handle the team were all the labor required for this feat. This test was made for the Bell Telephone Co. of Pennsylvania, and the Beacon Light Co., at Chester, Pa., who both approved the machine.

Can be used equally well in town or country. The saving in labor on 200 poles will pay for it.

It will pay anyone who has a number of poles to erect to investigate the merits of this money-saving machine.

Code Word,
JUDGMENT

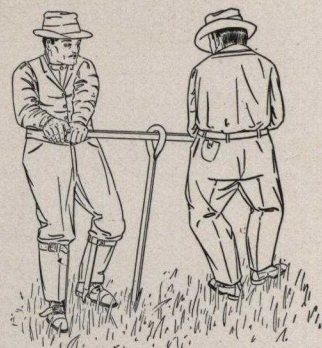
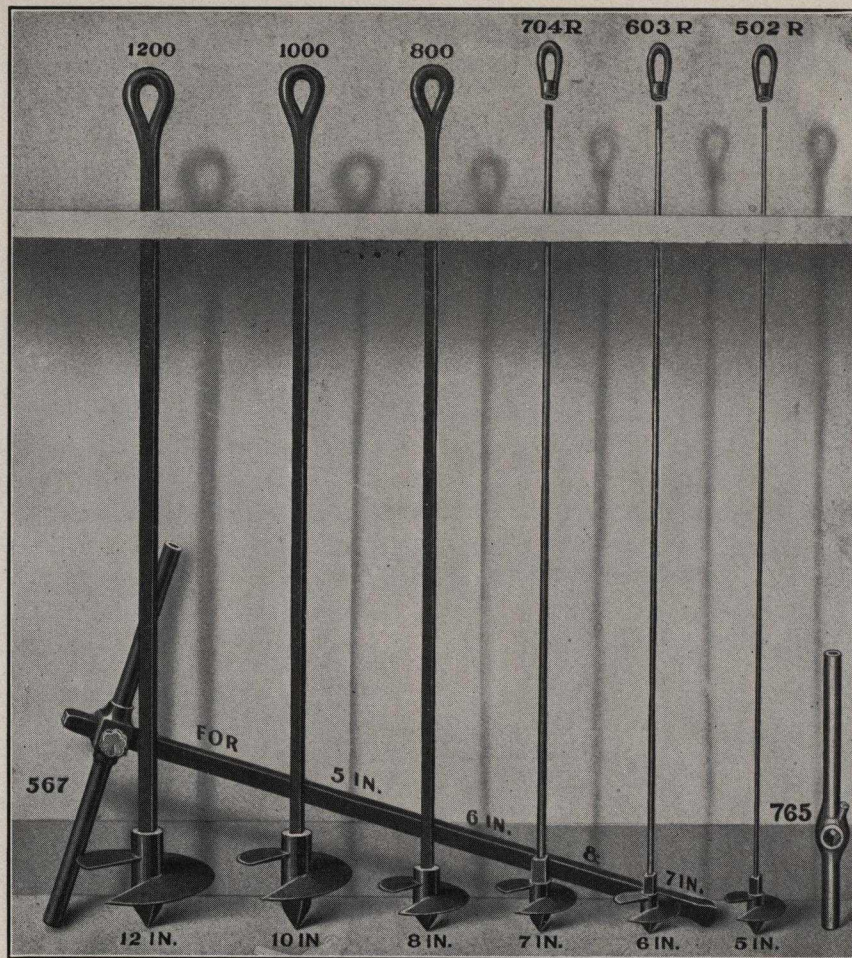
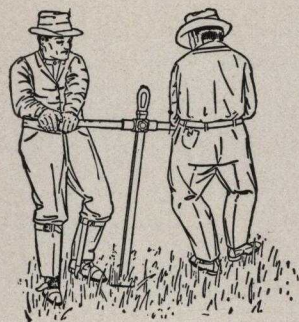
NET PRICE F. O. B. ST. LOUIS, MO., \$175.00 EACH

The above price does not include blocks and tackle or wagon. The machine is shipped ready to be mounted on a standard 12-foot bed wagon.

Shipping weight, approximately 950 pounds. (See pages 50 to 54.)

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.





MATTHEWS GUY ANCHORS

Patent Number 816631

These anchors were the first to be offered as a successful substitute for the "dead man." They are the most economical substitutes today. There has never been a year in the fifteen years that we have been selling them that the sales of Matthews' Guy Anchors have not exceeded by a considerable margin those of the year previous. Since this anchor was first placed on the market over 100 patents have been granted to those who have tried to get out a better one. About twenty of these have been placed on the market. About three of these are still trying to compete. Why is it that 100 brains have not been successful in devising an anchor that is better than the Matthews' Guy Anchor? It is because Matthews' Guy Anchor is so simple that it is not possible to beat it. It is the only anchor ever designed that is all in one piece and that can be screwed into the ground without digging. It is the only one ever made that has no moving parts to adjust or THAT MIGHT BE CARELESSLY BURIED UNADJUSTED. Just think of the responsibility that an engineer takes upon himself when he gives his laborers an article to install, the efficiency of which is dependent upon the correct adjustment of moving parts. Is it any wonder that most of them use Matthews' Guy Anchors, which they know will hold and which will tell them at a glance whether they have been properly installed?

NET QUANTITY PRICES, F. O. B. OUR FACTORY AT SIDNEY, OHIO

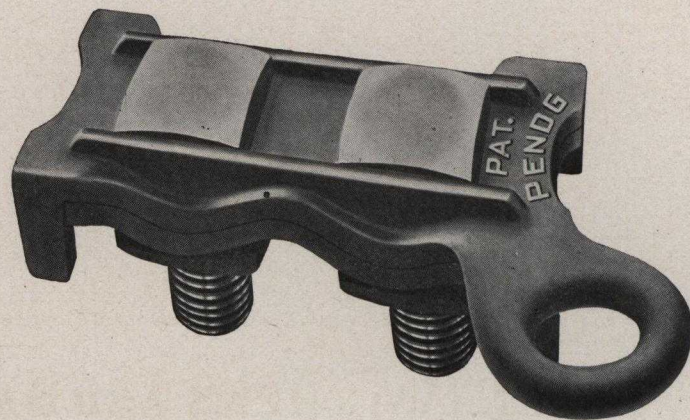
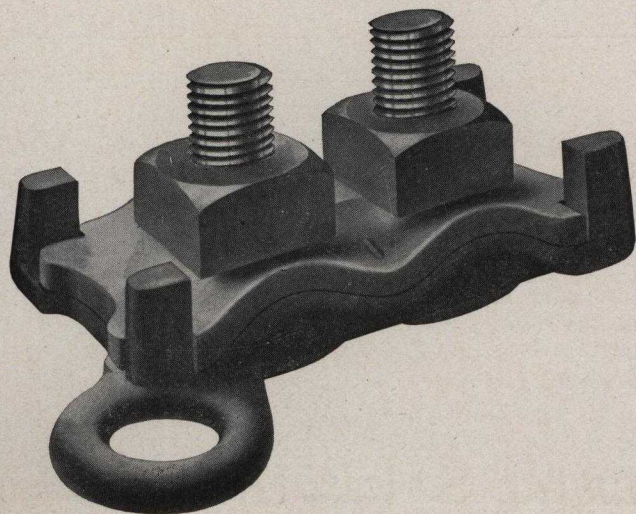
Code Words	Trade Nos.	Diameter of Anchor	Prices less than 12, per 100	Prices less than 50 and over 11, per 100	Prices 50 or more, per 100	Galvanizing, per 100	Weight, pounds, per 100	Size of Rods	Description
Acceptable	500	5 in.	\$ 55.00	\$ 45.50	\$ 42.00	None	250	None	For detailed information see pages 54 to 75.
Appealing	600	6 in.	95.00	81.25	75.00	None	450	None	
Approved	502R	5 in.	85.00	74.75	69.00	\$23.00	650	½ inch round	
Adequate	603R	6 in.	160.00	146.25	135.00	35.00	1,000	¾ inch round	
Adhere	704R	7 in.	270.00	270.00	270.00	52.00	1,500	¾ inch round	
Adaptable	567	Wrench	331.50	331.50	306.00	None	2,500	Wrench	
Appreciated	*765	Handle	350.00	350.00	350.00	None	700	Ratchet Handle	
Absolute	1,332	Above Combined	500.00	500.00	500.00	None	3,200	Above Combined	
Authenticated	800	8 in.	450.00	450.00	450.00	\$133.00	3,800	1 ⅞ in. square	
Ability	1,000	10 in.	675.00	675.00	675.00	175.00	5,000	1 ¼ in. square	
Astonishing	1,200	12 in.	900.00	900.00	900.00	280.00	8,000	1 ½ in. square	

All rod anchors are 6 feet long over all. Rodless anchors are never furnished galvanized. A number 567 wrench must be used with all anchors smaller than 800. No wrench is needed for the 800, 1,000 or 1,200 anchors. **See Trial Proposition on page 5.**

*The 765 ratchet handle is for use with the 567 wrench, and is very useful where it is desired to put the anchor down next to walls, fences, etc. **Do not confuse the ratchet handle with the 567 wrench.**

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS BOLTLESS GUY CLAMPS

Invented by Claude L. Matthews—Patent Number 988481—Other Patents Pending

These clamps are so simple that one wonders why they were not invented long ago. Simply a wedge and a sleeve. The guy strand is passed through the sleeve and then through the eye of the anchor or around the pole, and then through the sleeve again. Then the wedge is driven in with an ordinary hammer until it will go no farther. When the wedge is driven home the clamp can not slip. It can be put on in less than three minutes and will hold more than any 3-bolt clamp.

Matthews' Boltless Guy Clamps are made in two sizes, known as The Baby and The Giant.

Matthews' Baby Boltless Guy Clamp is designed for use on ¼-inch and 5/16-inch guy strand. It is generally used by electric railways for holding their ¼-inch trolley span wires and by all wire-using companies for holding their ¼ and 5/16-inch guy strand.

Matthews' Giant Boltless Guy Clamp is designed for use on 5/16 and ¾-inch guy strand. It is generally used by wire-using companies for all pole and anchor guying for the sizes of strand mentioned above. It will safely hold strains up to 8,100 pounds. See pages 76 and 77.

Quantity.		NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.		Baby	Giant
Less than 500.....	per 100			\$10.00	\$15.00
500, less than 1,000.....	per 100			same	14.00
1,000 or more.....	per 100			8.00	13.00
Shipping weight per 100.....				50 pounds	130 pounds
Code words.....				Economical	Efficient

See trial order proposition on page 5. For detailed information on Matthews' Boltless Clamps, see pages 75 to 83.

MATTHEWS 2-BOLT GUY CLAMP

Invented by Sylvester B. Way—Patent Pending

Can not slip after the two bolts are fully tightened. Two linemen can install in less than 4 minutes. Eliminates beating up of guy wires and clamps, because it is pulled to place by attaching a chain lever to the eye. Combines the advantages of the Crosby Clip and the clamp. Guys can not jump out. Heavy machine bolts used. Threads can not strip. Will hold three times as much as an ordinary 3-bolt clamp. Fits guy and messenger strand from 3/16-inch to 5/8-inch in diameter. Will hold 16,000 pounds. Strongest clamp made.

Quantity.		NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.		Each.
Less than 1,000.....	Code Word, TAUT			\$0.22
1,000 and over.....				.20
Chain levers.....				1.50

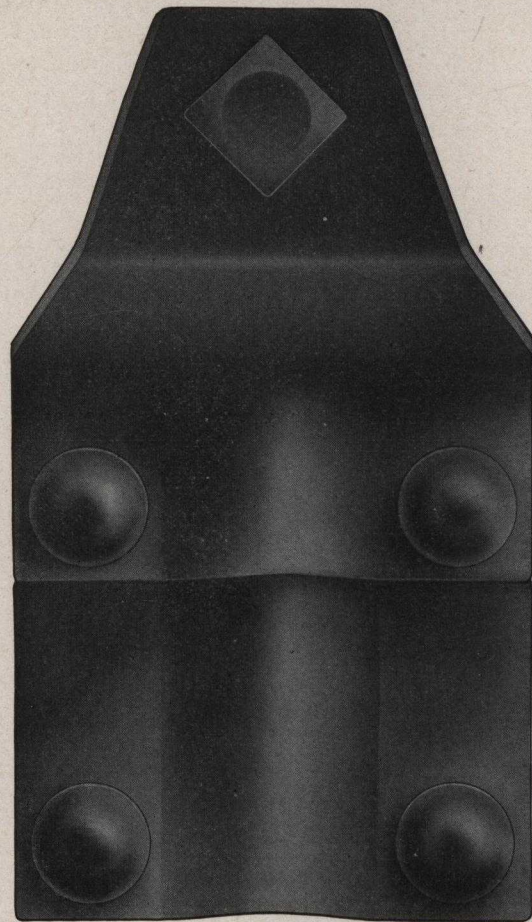
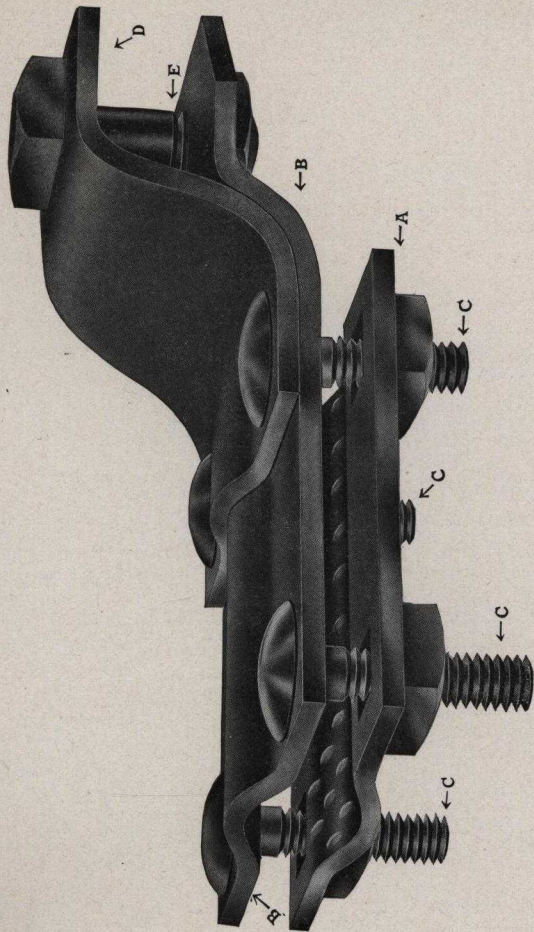
One chain lever is needed for each crew. Weight of clamp, 1¾ pounds each.

If orders for Matthews' 2-Bolt Guy Clamp are combined with orders for Matthews' Boltless Guy Clamps, the quantity prices may be applied to the combined total, i. e., 500 2-Bolt, 250 Giant, 250 Baby=1,000. Prices as follows: 2-Bolt, 20c; Giant, 13c; Baby, 8c, each.

See trial order proposition on page 5. See pages 164 to 167.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS CABLE CLAMP

Invented by James R. Kearney—Patent Number 801250

Not for telephone cables. Matthews' Cable Clamp is designed to relieve the strain at corners and dead ends from power cable ranging in size from 000 up to 2,000,000 C. M. and to do away with the great expense of splices at these places and the cost of making up into strain insulators, etc. This clamp is guaranteed to effect a saving of at least \$5.00 per corner turn in cables 500,000 C. M. and larger.

If you find after a thirty days' test of Matthews' Cable Clamps that they do not save you at least \$5.00 per corner per cable, they may be shipped back to us, freight charges collect, and you will receive a cancellation of our bill.

NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.

Quantity.	Code Word, BENEFICIAL	Price per 100	
		Painted Black.	Galvanized.
Less than 25.....		\$110.00	\$120.00
25 to 49.....		105.00	115.00
50 or more.....		100.00	110.00

See trial proposition on page 5.

In quantities of 500 or more, when ordered in one shipment from factory stock, special discounts will be made.

Matthews' Cable Clamp is made in only one size, which will fit all cables larger than 00 and up to and including 1,500,000 C. M.*

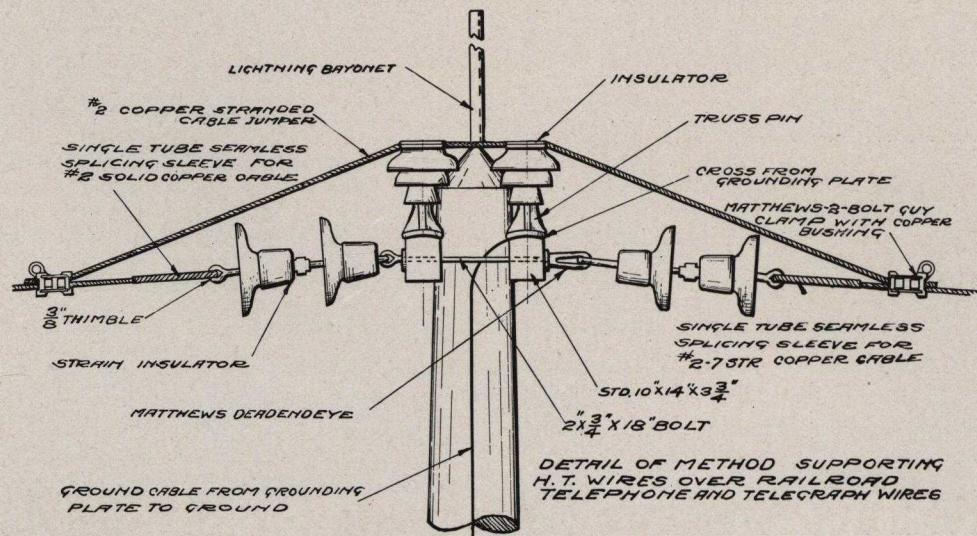
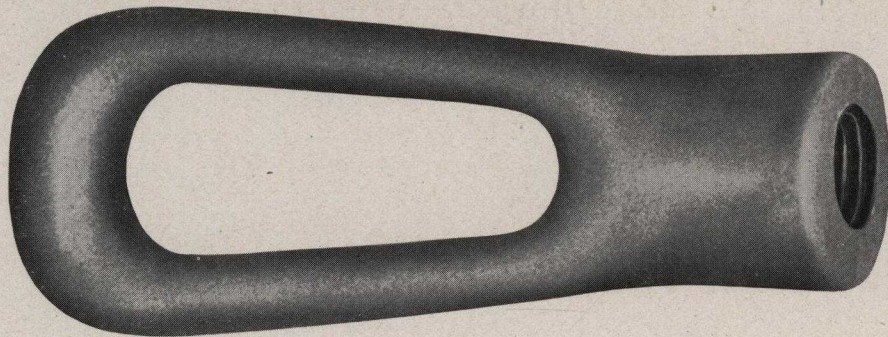
Matthews' Cable Clamp weighs four pounds (4 lbs.). It is packed in cases containing 12 and 25 each.

For detailed information pertaining to Matthews' Cable Clamp, see pages 83 to 94.

*For cables smaller than 000 (Nos. 0 and 00) Matthews' 2-Bolt Clamp described on page 11 can be used to good advantage.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS DEADENDEYES

OR EYENUTS

This is a money-saving device that is being used extensively by pole-using companies.

It is particularly valuable to power companies for supporting high tension wires at crossings as shown on drawing opposite. If it is not used it is necessary to use two eyebolts for supporting each cable. By using Matthews' Deadendeye it is only necessary to use one eyebolt, as it can be threaded onto the threaded end of the eyebolt in place of the nut. This saves—one eyebolt; the labor of boring one additional eyebolt hole in the cross arms, and prevents weakening the cross arms because of the elimination of this extra hole.

Matthews' Deadendeye can be used on eyebolts shown on cross arms in Figs. 13 to 19 on page 90, and in each case where they are used do away with one eyebolt.

Matthews' Deadendeyes are made of malleable iron. They are furnished either with black japanned finish or Sherardized.*

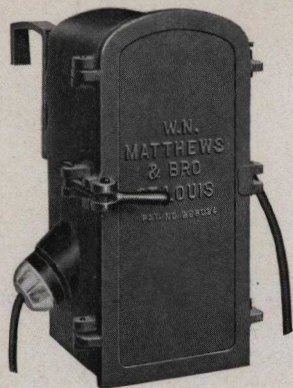
NET PRICES IN ANY QUANTITY, F. O. B. OUR FACTORY AT SIDNEY, OHIO

Code Words	Trade No.	Description	Weight	Price Black each	Price Sherardized each
Yoke	No. 1	For 1/2-inch eyebolts.....	1 lb.	\$0.15	\$0.18
Yoking	No. 2	For 5/8-inch eyebolts.....	15 1/2 oz.	.15	.18
Yokeye	No. 3	For 3/4-inch eyebolts.....	15 oz.	.15	.18

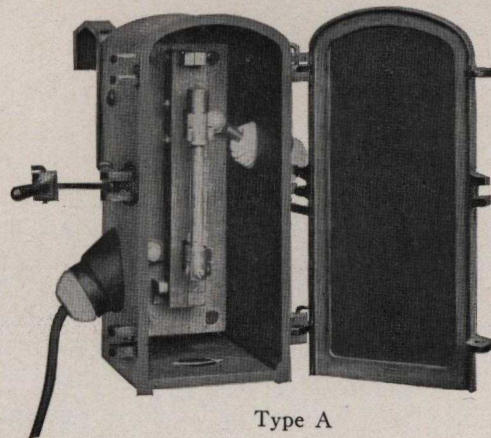
*See page 177 for description of Sherardizing.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.
FOURTH CITY

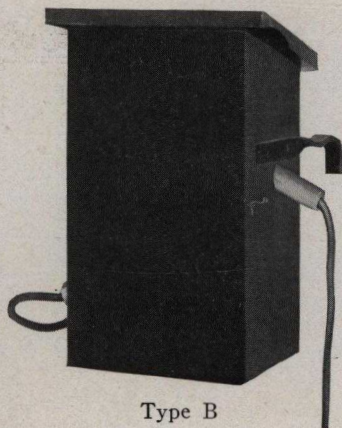




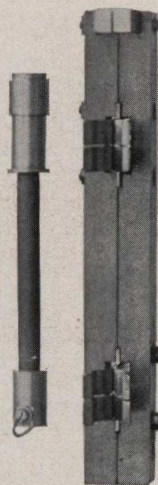
Type A



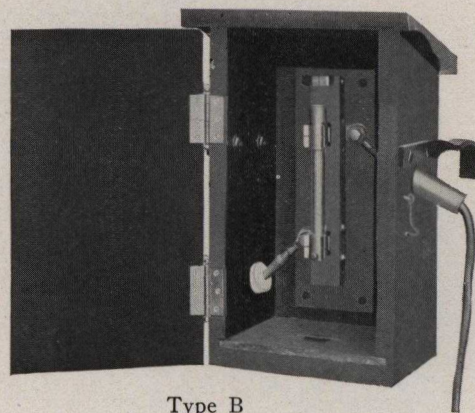
Type A



Type B



Types A and B
Fuse Cartridge
and
Switch Blade



Type B

MATTHEWS FUSE SWITCHES

Invented by John L. Fay and S. B. Way—Patent Number 989034

Combines in one device two very important and desirable pieces of apparatus required in the operation of overhead primary lines, *i. e.*, the fuse block and the primary line disconnecting switch.

The boxes are designed so as to be weatherproof when closed. The door is so arranged that it can be opened either to the right or left simply by changing the hinges and the latch pins from left to right. This can be done on the job by the workman in less than five minutes if a change is necessary. Made in three sizes and four types. Types A and B for use on voltages from 1,100 to 6,600 and 60 amperes or less. The only difference between the Type A and Type B is that the first is furnished in cast-iron boxes and the second is furnished to those who prefer wood boxes. The Type F Matthews' Fuse Switch is furnished in wood boxes only. It is designed for voltages ranging from 1,100 to 6,600 and capacities from 60 to 100 amperes, inclusive. The Type H Matthews' Fuse Switch is furnished in wood boxes only. It is designed for voltages ranging from 6,600 to 14,200 and for capacities up to 75 amperes. The Type H is displacing the more expensive and less efficient oil switch.

Matthews' Fuse Switches are recommended for fusing branch lines and for fusing large capacity transformers (40 K. W. or over).

NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.

Quantity	Code Words..... Voltages Amperes	Types A* or B	Type F	Type H
		Type A, Warrant Type B, Warrantable Less than 6,600 60 and less	Warranting Less than 6,600 100 and less	Warranted 6,600 to 14,200 75 and less
Less than 12.....	Complete, including fuse cartridges, hangers, leading-in wires, insulators and fuse wires for two charges.....	\$15.75 each	\$21.50 each	\$43.50 each
12 to 24.....		14.50 each	20.00 each	41.40 each
25 or more.....		13.25 each	19.00 each	39.30 each
	Extra Expulsion Fuse Cartridges.....	\$ 0.75 each	\$ 1.50 each	\$ 3.00 each
	Code words for above cartridges.....	Whiff	Whiffing	Whiffed
	Extra Aluminum Fuse Wire made up in lengths all ready to use. All amperes from 5 to 100, inclusive.....	\$ 0.02 each	\$ 0.03 each	\$ 0.04 each
	Shipping weight, pounds.....	A 50, B 35	F 50	H 110

*Some orders have been received for galvanized Type A boxes. These can be furnished at \$1.75 net, extra.

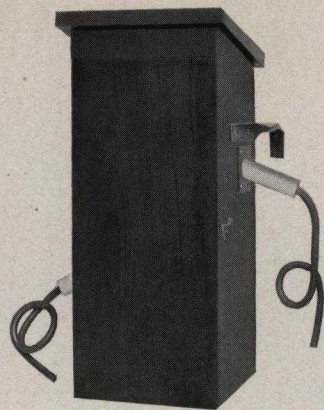
See page 5 for liberal trial proposition.

Specify voltage, amperes and size of cross arms when ordering. Always order Aluminum fuse wire for use with Matthews' Fuse Switches. Don't use any other kind. Prompt shipment can be made of all four types.

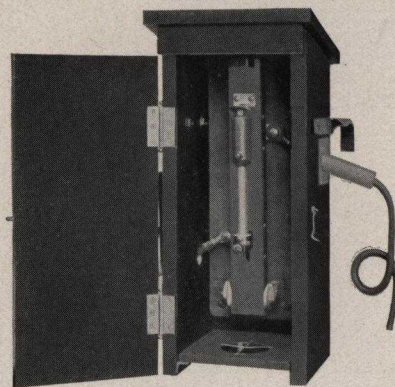
For detailed information pertaining to Matthews' Fuse Switches, see pages 94 to 105 and 136.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

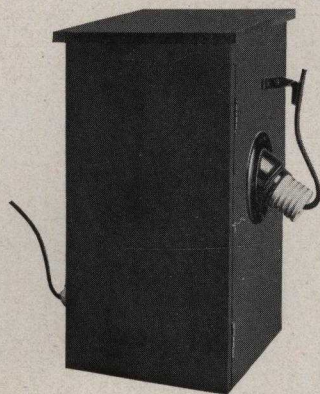




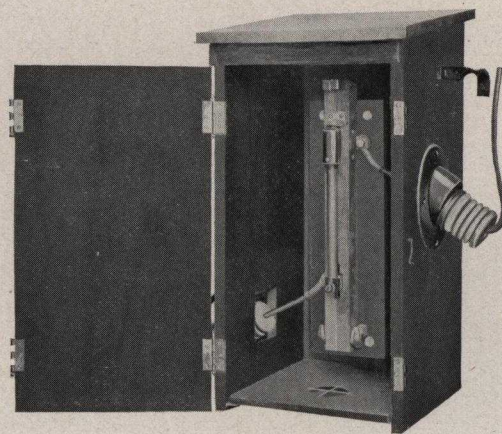
Type F



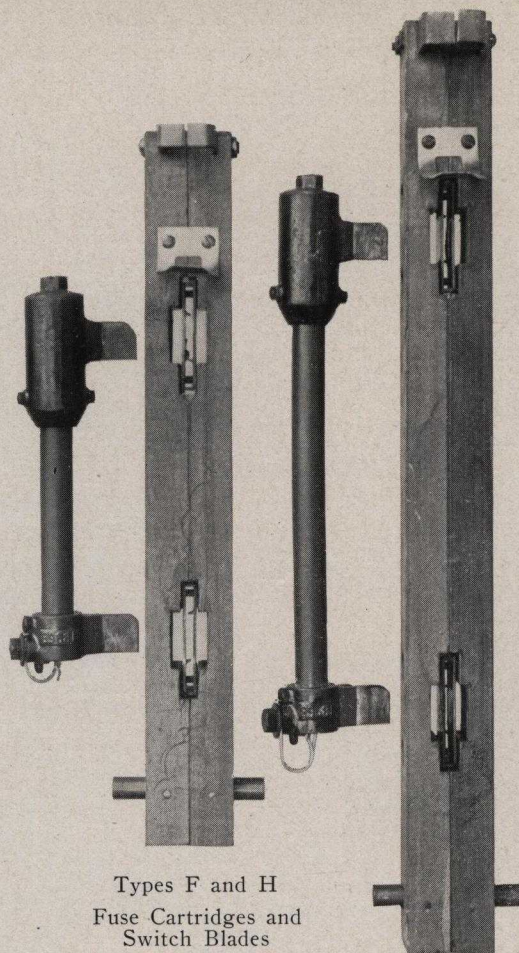
Type F



Type H



Type H



Types F and H
Fuse Cartridges and
Switch Blades

MATTHEWS FUSE SWITCHES—Continued

DUPLICATE PARTS LIST. NET PRICE, F. O. B. ST. LOUIS, MO.

Those for which there may be a call are listed below and the net prices are given.

Code Word	Description	Price each	Code Word	Description	Price each
	<i>Type A.</i>			<i>Type F.</i>	
Wonder	Cartridge Holder	\$ 5.00	Winning	Cartridge Holder	\$ 6.00
Wonderful	Base Complete	5.00	Winner	Base Complete	10.00
Wondering	Brass Locking Handle	.50	Window	Transite Bottom	.75
Wonderly	Door	1.50	Winsomeness	Insulators	.30
Wonderer	Transite Bottom	.50	Winsome	Cross Arm Hangers	.35
Wonderness	Insulators	.25			
Wonderingly	Cross Arm Hangers	.25			
	<i>Type B.</i>			<i>Type H.</i>	
Wonder	Cartridge Holder	5.00	Watching	Cartridge Holder	12.00
Wonderful	Base Complete	5.00	Watchful	Base Complete	20.00
Wooded	Transite Bottom	.60	Watchfulness	Transite Bottom	1.00
Woodland	Insulators	.25	Watch	Insulators	.40
Woody	Cross Arm Hangers	.30	Watcher	Cross Arm Hangers	.40

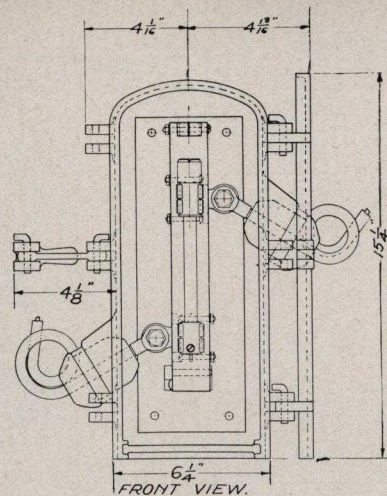
ALUMINUM FUSE WIRE CARRIED IN STOCK

Capacity Amperes	Approximate			Net price, per pound	Capacity Amperes	Approximate			Net price, per pound
	Feet per pound	No. of A, B and F Fuses	No. of H Fuses			Feet per pound	No. of A, B and F Fuses	No. of H Fuses	
5	14,000	11,200	7,000	\$7.50	50	400	320	200	\$1.30
10	6,000	4,800	3,000	7.50	55	350	280	175	1.30
15	2,000	1,600	1,000	7.50	60	300	240	150	1.30
20	1,300	1,040	650	1.50	65	275	220	137	1.30
25	1,000	800	500	1.40	70	240	192	120	1.30
30	800	640	400	1.40	75	220	176	110	1.25
35	650	520	325	1.35	80	200	160	100	1.25
40	500	400	250	1.35	90	180	144	90	1.25
45	435	348	217	1.35	100	143	114	71	1.20

Don't use anything but Aluminum Fuse Wire in Matthews' Fuse Switches. It is more accurate as to rating and does not form as much gas as zinc-lead and other fuses.

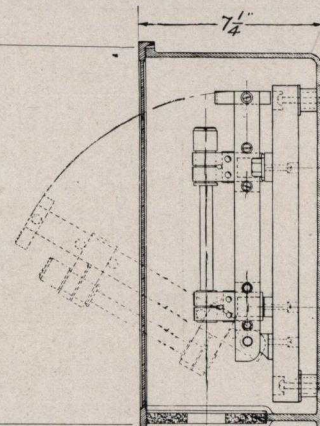
W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



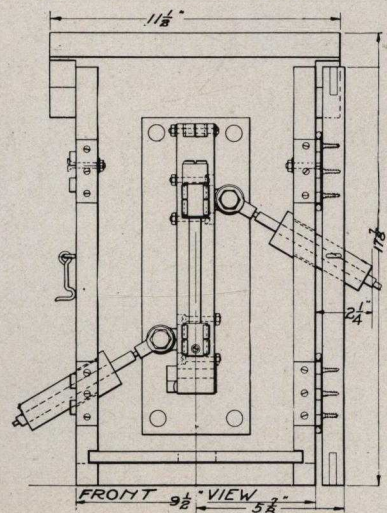


Type A

THE SWITCH THAT
BLOWS
WHEN TROUBLE
SHOWS

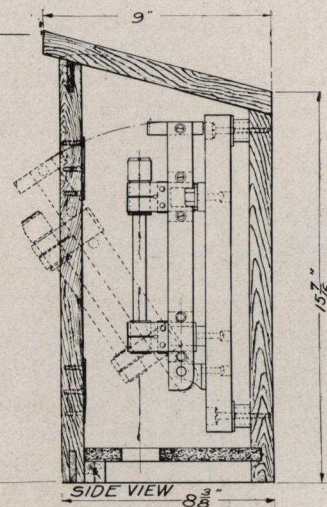


Type A

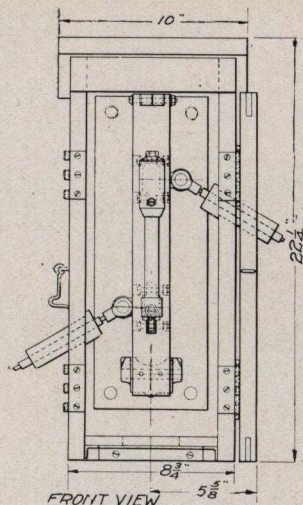


Type B

SAFETY
FIRST

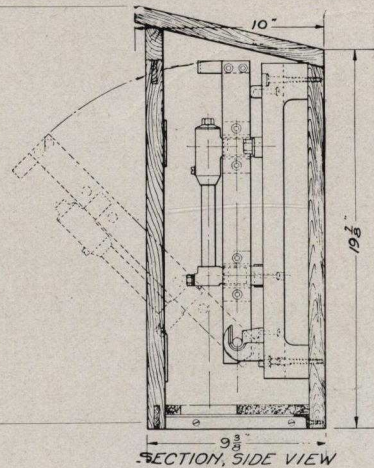


Type B

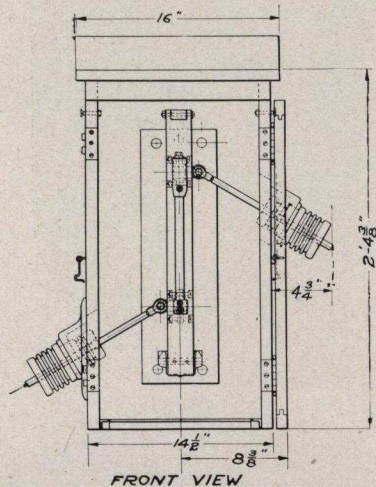


Type F

THE SWITCH THAT
BLOWS
WHEN TROUBLE
SHOWS

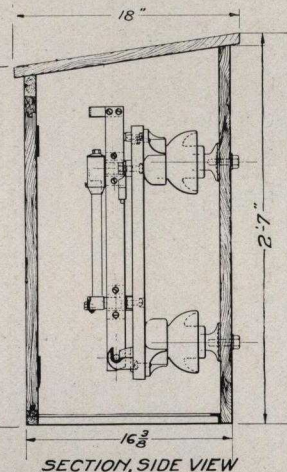


Type F

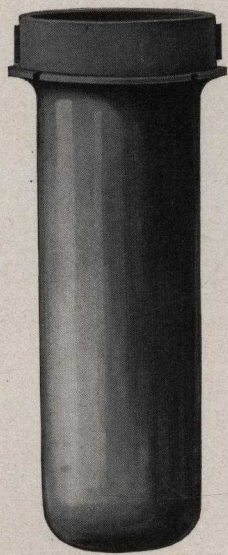


Type H

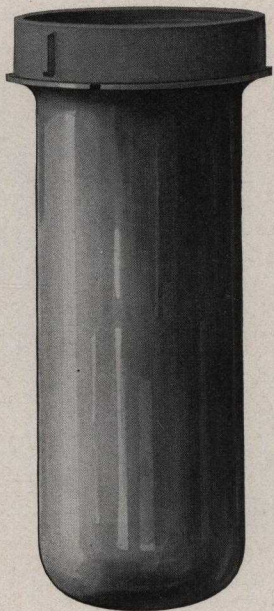
SAFETY
FIRST



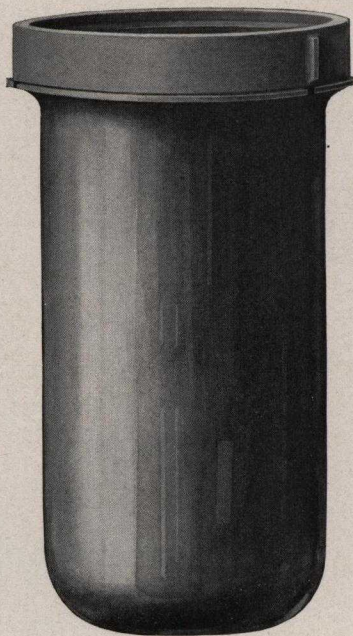
Type H



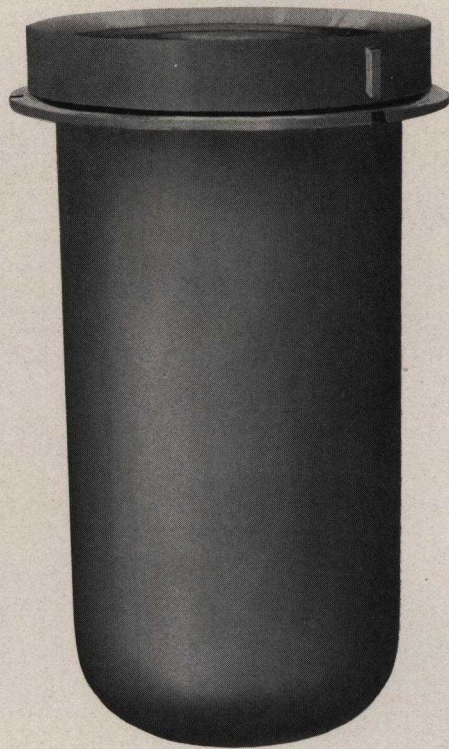
Number 1



Number 2



Number 3



Number 4

MATTHEWS CABLE SPlicing JOINTS

Invented by Luther Hargis—Patent Number 802337

"A cable is no better than its weakest splice." The point most likely to be weak is the splice. When once they are made and proven to be secure, it is poor policy, no matter what may occur, to remake them after having opened them, but of course this must be done where the old form of splice is used. Much "trouble" has been caused on account of the necessity for opening splices, to say nothing of the cost of such operations and the loss of time in preparing for changes in service, and its consequent loss of revenue. Matthews' Cable Splicing Joints were invented to do away with these troubles and the consequent expenses. They afford a perfectly moisture-proof splice that is accessible when conditions mentioned above arise. This joint is principally and most successfully used in underground installations of Telephone, Telegraph, Police and Fire Alarm Cables. It has also been successfully used in a number of cases for splicing power cables.

No. 1 MATTHEWS CABLE SPlicing JOINT

Weight, 3 lbs., inside dimensions $2\frac{1}{4} \times 8$ inches. Will take for straight away splice any cable up to and including 1 inch, outside diameter, for each cable. Will take for branch splice 50 pair in, 2-50's out; 50 pair in, 50 out, and a 10, 15 and 25 pair tap; 25 pair in, 25 out and a 10, 15 and 25 pair tap, etc.

No. 2 MATTHEWS CABLE SPlicing JOINT

Weight, 4 lbs., inside dimensions $3\frac{1}{4} \times 8$ inches. Will take for straight away splice any cable up to and including $1\frac{1}{2}$ inch, outside diameter, for each cable. Will take for branch splice 100 pair in, 100 out and a 10, 15, 25 and 50 pair tap; 100 pair in, 75 out and a 10, 15, 25 and 50 pair tap; 100 pair in and 3-50's out, etc.

No. 3 MATTHEWS CABLE SPlicing JOINT

Weight, $7\frac{1}{2}$ lbs., inside dimensions $4\frac{3}{4} \times 9$ inches. Will take for straight away splice any cable up to and including $2\frac{1}{2}$ inches, outside diameter, for each cable. Will take for branch splice 300 pair in, 300 and 150 out; 300 pair in 200 and 200 out; 200 pair in 200, 150 and 100 pair out, etc.

No. 4 MATTHEWS CABLE SPlicing JOINT

Weight, 15 lbs., inside dimensions $5\frac{3}{4} \times 11\frac{1}{4}$ inches. Will take for straight away splices any cable up to and including $2\frac{3}{4}$ inches outside diameter for each cable. Made on special orders only. Not carried in stock. All Matthews' Cable Splicing Joints are furnished with a galvanized iron lining to prevent denting the lead pot. Use red lead on threads.

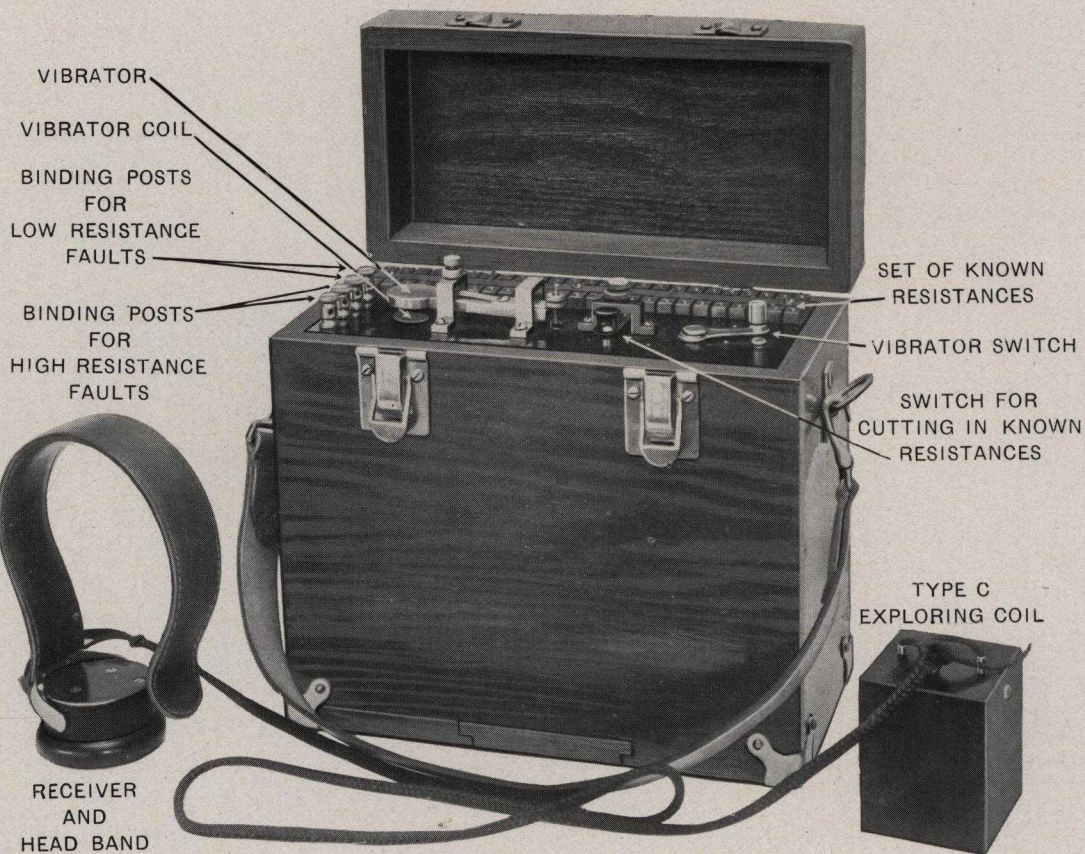
NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.

Code Words	Trade Numbers	Less than 25	25 to 49	50 or more	Code Words	Trade Numbers	Spanner Wrenches Per Pair
Damproof	No. 1.....	\$2.40 each	\$2.28 each	\$2.20 each	Dry	No. 1.....	50 cents
Demonstrated	No. 2.....	3.00 each	2.85 each	2.75 each	Dryness	No. 2.....	55 cents
Desirable	No. 3.....	4.80 each	4.56 each	4.40 each	Drying	No. 3.....	75 cents
Distinctive	No. 4.....	7.50 each	7.12 each	6.87 each	Dryly	No. 4.....	90 cents

Spanner wrenches will only fit the joint for which they are made. Quantities may consist of an assortment of various sizes of joints. For detailed information pertaining to Matthews' Cable Splicing Joints, see pages 105 to 115. See Trial Proposition on page 5.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS TYPE "C" TELEFAULT

Invented by O. F. Tallman and Fred E. Hubert—Patents Pending

Matthews' Type C Telefault, the simple self-contained instrument shown on page 24, will exactly locate water in cables, shorts of all kinds in cables, crosses, grounds, split pairs—in fact, everything except "opens." The Type C Matthews' Telefault is a great improvement over the Type A Matthews' Telefault. It retains all of the good features of the Type A and to them adds certain very important improvements. Most wireless fault-finders use about 45 volts. Matthews' Type A Telefault uses 28 volts. Matthews' Type C Telefault only uses about 4 volts. The use of high voltage causes the "noising up" of other working pairs, because of the inductive field created. That is why the Type A Matthews' Telefault was better than all the others. That is one of the reasons why the Type C Matthews' Telefault is far superior to the Type A.

The Type C Telefault, equipped with batteries, weighs $11\frac{1}{4}$ pounds less than the Type A. This is because it only requires one dry battery to operate it. This means the elimination of three dry-battery cells and the necessary space to take care of them.

The tone from the vibrator of the Type C Matthews' Telefault sounds like a riveting hammer—not a hum. It can't be confused. The exploring coil that is regularly furnished with the Type C Matthews' Telefault is entirely different from the little double-barreled coil that is furnished with the Type A Matthews' Telefault. It is very much more efficient, with one exception, which is that it may occasionally give a false location, due to a stray sheath current. The only way to eliminate this possibility is to use the Type A Exploring Coil. This coil has differential windings that tend to neutralize stray sheath currents. If you have these conditions it will be advisable to send us an additional order for a Type A Exploring Coil.

The Type C Matthews' Telefault, in addition to having all the good features of the Type A, has the following additional and very valuable feature: This is a set of known or calibrated resistances, which, with the proper manipulation, enables the trouble man to approximately locate the trouble before starting from the office. This saves an immense amount of time, trouble and expense. The instrument contains full directions for its operation.

In addition to using it for finding faults in cables, Matthews' Type C Telefault can be used as a tone test set, by simply adding a condenser in series with one of the line binding posts. It can be used as a "howler" to make subscribers hang up telephone receiver when it has been accidentally left off the hook. Matthews' Type C Telefault will find all kinds of trouble inherent to telephone, telegraph, signal and power cables, except "opens." This makes it a great extravagance for any company using such cables not to have one.

Matthews' Type C Telefault can also be used for locating metal pipes—water, gas, conduits, etc.—either underground or concealed in the walls of buildings. It has taken the place of Matthews' Telepipe. We guarantee Matthews' Type C Telefault to locate grounds, shorts, crosses and wet spots of either high or low resistance. Operates on one dry battery. Matthews' Type C Telefault is held in a neat, strong case, furnished with strong carrying strap. The vibrator, battery, head phone and exploring coil are all contained in this box.

NET PRICES F. O. B. ST. LOUIS, MO.

Matthews' Type C Telefault, each complete.....	\$50.00
Type C Exploring Coil.....	15.00
Type C Receivers.....	1.50

No batteries furnished. Shipping weight 12 pounds. **Shipped by express unless otherwise specified.**
See trial proposition on page 5. For detailed information see pages 115 to 128

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS TYPE "B" TELEFAULT

Invented by John L. Fay—Patents Applied For

Matthews' Type B Telefault is the instrument that the central station man has been hoping to see for some time. It is a convenient instrument which really locates all faults in single or multi-conductor power cables, excepting "opens."

To gain an idea of the simplicity of the Type B Matthews' Telefault read the directions for operating below:

First: Determine if the cable has burned itself clear and is open, in which case this instrument will not work.

Second: If you find that the trouble is due to a ground, connect one binding post of the Matthews' Telefault Instrument by a wire to the lead sheath, the other to the wire or wires in trouble. Slide the Telefault Exploring Coil along the cable in the manhole, if underground, and along the cable, if aerial, until the noise ceases. You will hear the tone in the receiver up to a point about two feet beyond the trouble, therefore, open the cable for fault about two feet before the sound stops.

Third: If the trouble is a short circuit or multi-conductor trouble in a multi-conductor cable, then attach the Telefault Instrument to the wire in trouble and proceed to test the same, as described for grounds.

Fourth: In order to identify the inductive tone in the receiver beyond a question of doubt press the key on the Telefault Exploring Coil, which has a certain action on the coils within, which will cause the tone of the receiver to increase or decrease, coincident with the pressure of the key.

Fifth: The Telefault Exploring Coil is so sensitive that live cables paralleling the cables which you are testing will give you a slight hum, but you can easily distinguish the difference in the tone produced by a working cable, as against the tone produced by the Telefault Instrument attached to the cable you are using.

Sixth: The Type B Telefault Exploring Coil will locate single conductor trouble easily as well as multi-conductor trouble.

In some States the law requires that a cable be tested before the workman is permitted to cut into it to make repairs. Matthews' Type B Telefault can be used for this purpose as well as for the finding trouble.

Read the article on page 127 by L. H. Gamp, on pages 125 and 126 by John L. Fay, and the letters from The Cliff Distributing Co. and the Duquesne Lighting Co., on page 128.

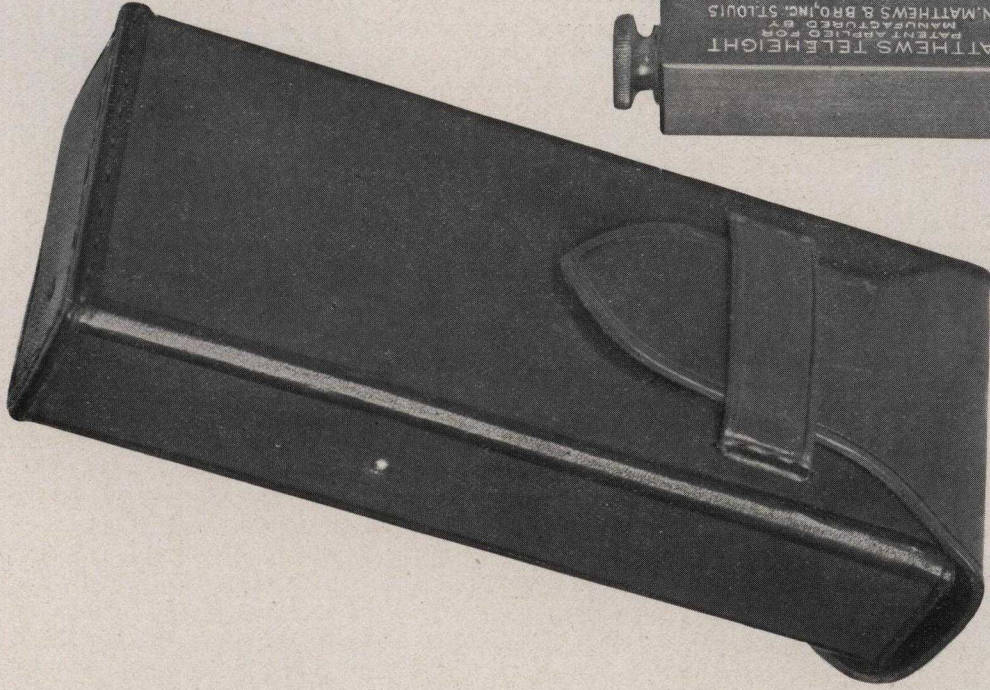
NET PRICES F. O. B. ST. LOUIS, MO.

Matthews' Type B Telefault, complete	\$45.00 each
Matthews' Type B Exploring Coil	15.00 each
Matthews' Type B Receiver	3.00 each

Operated on four dry batteries. No batteries furnished by us. Shipping weight 20 pounds. Shipped by express unless otherwise specified. See trial proposition on page 5.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS TELEHEIGHTS

Invented by John L. Fay and S. B. Way—Patents Pending

These simple little instruments are designed for the use of intelligent men who have not had the advantage of a technical education and they will save much of the time of the technical graduate.

The Type A Matthews' Teleheight is so designed that any person can sight over an object (such as a tree) to be crossed and read directly on a scale the length of the pole required to give five feet clearance when set in the ground at the proper depth according to the specifications of the National Electric Light Association.

The Type B Matthews' Teleheight is the same as the type A, except that it is designed to fit the specifications of the American Telephone and Telegraph Company as to pole depths.

The Type C Matthews' Teleheight is the same as the above, except that it gives the exact height in feet of any object above the ground.

The Types A, B and C have a range of from 20 to 75 feet.

The only difference between the Type A, B and C Matthews' Teleheights is in the scales.

NET PRICE, F. O. B. ST. LOUIS, MO.

Types A, B or C..... \$15.00 each

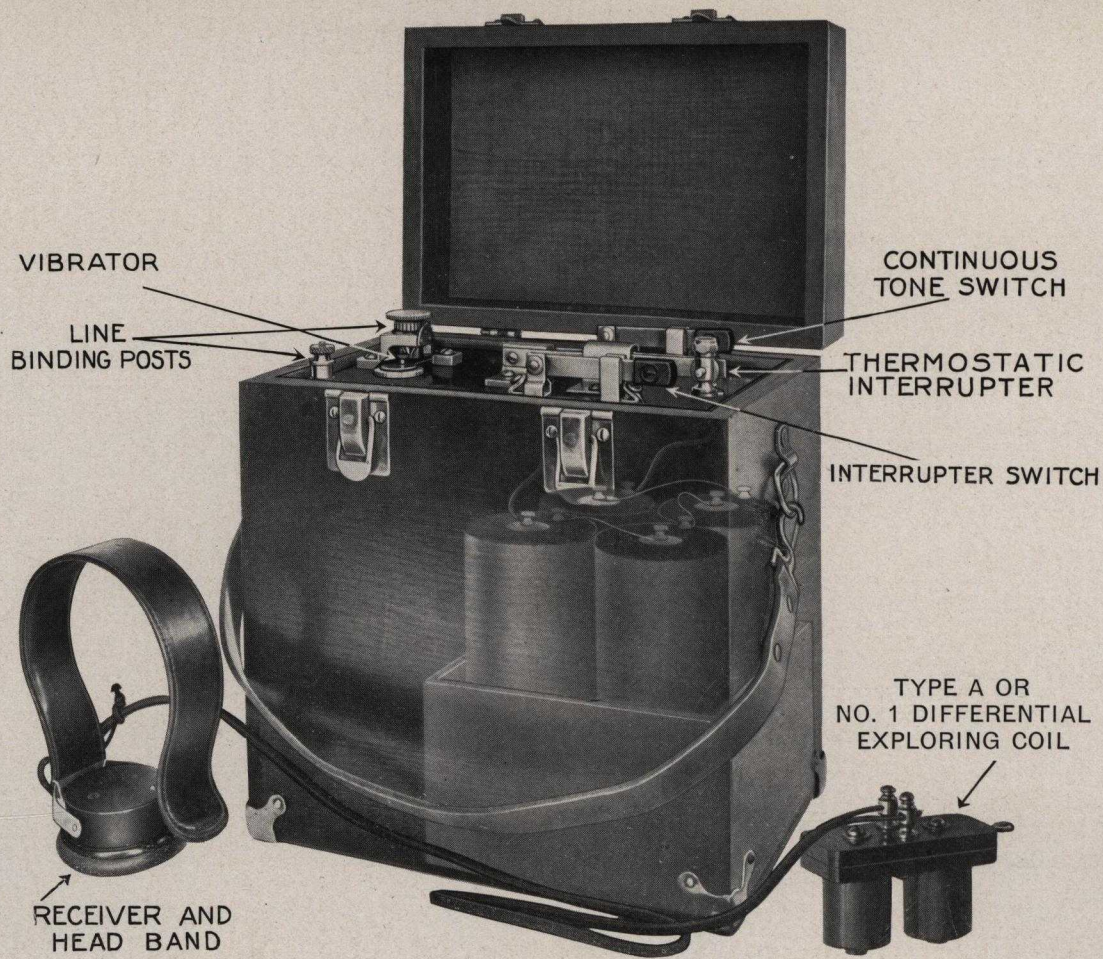
Code Words, Type A, HELPFUL; Type B, HANDSOME; Type C, HANDY.

The price of \$15.00 includes a neat leather carrying case. Weight complete, 14 ounces.

See trial proposition on page 5. Fits in back pocket. For further information, see pages 129 to 132.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS TYPE "A" TELEFAULT

Invented by H. L. Hoffmann, W. O. Pennell and others

Patent Number 925594—Patents Pending

Matthews' Type A Telefault, the simple, self-contained instrument shown on page 30, will exactly locate: Water in cable; shorts of all kinds in cable; grounds, crosses, split pairs, etc.

Matthews' Type A Telefault can be used as a tone test set by simply adding a condenser in series with one of the line binding posts.

Matthews' Type A Telefault makes the best "Howler" to make subscribers hang up the telephone receiver when it has been accidentally left off the hook that has ever been invented. Simply connect it to a switchboard cord and plug in on the offending line.

Matthews' Type A Telefault will find all kinds of troubles inherent to Telephone, Telegraph and Power Cables except "opens." This makes it a great extravagance for any company using such cables not to have one.

We guarantee it to locate grounds, shorts, crosses and wet spots of either low or high resistance. Operates on four dry batteries.

Matthews' Type A Telefault is held in a neat, strong case, furnished with a strong carrying strap. The vibrator, batteries, head phone and Type A exploring coil are all contained in this box.

NET PRICES F. O. B. ST. LOUIS, MO.

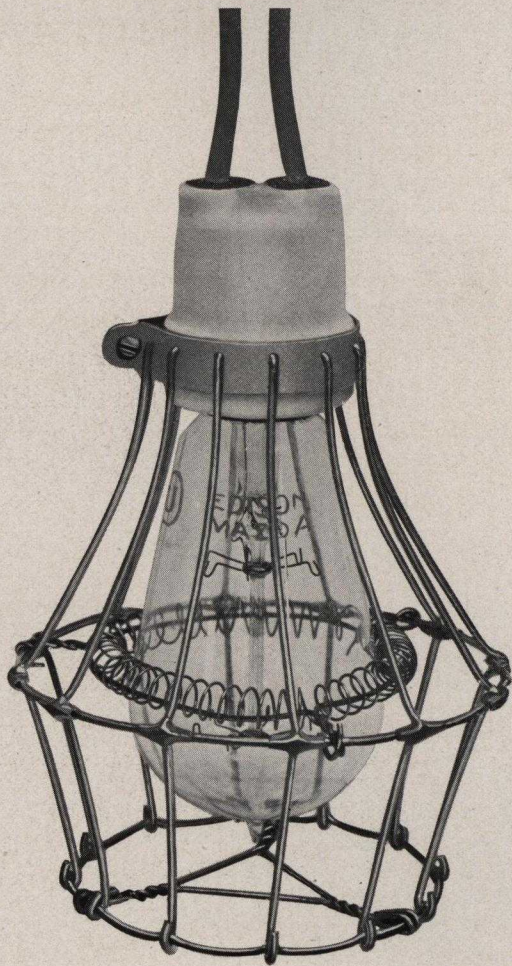
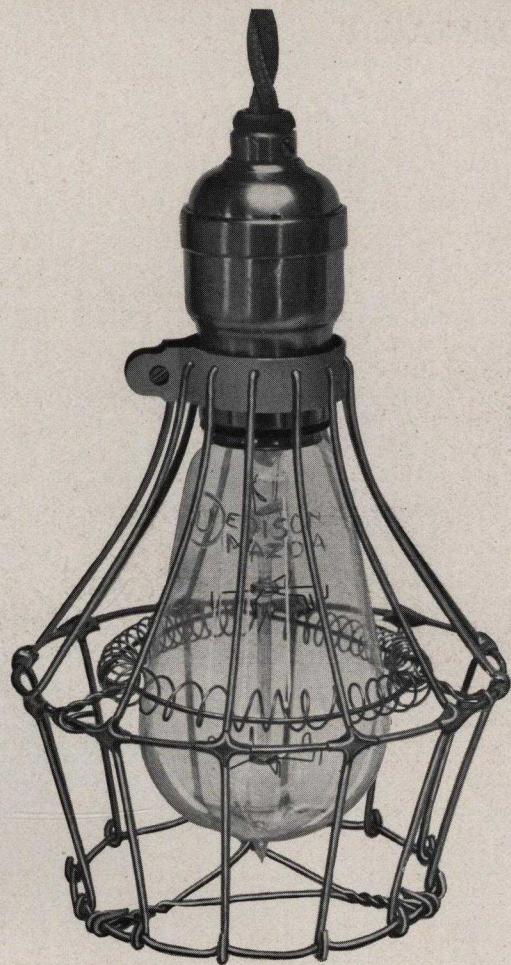
Matthews' Type A Telefault complete.....	\$45.00 each
Extra Matthews' Type A Exploring Coils.....	15.00 each
Extra Matthews' Type A Receivers.....	3.00 each

No batteries furnished. Shipping weight, 15 pounds. **Shipped by express unless otherwise specified.**

For detailed information pertaining to Matthews' Type A Telefault, see pages 115 to 125 and 134 and 135.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





MATTHEWS HOLDFAST LAMP GUARDS

Invented by Charles P. Anderson and W. N. Matthews—Patents Numbers 797250 and 997460

The only guard made that can be slammed against a solid wall and save the lamp.

Its rigid construction, the fact that it clamps on the socket, and the patented spiral spring cushion shock absorber in the center, make it the most perfect protection for electric lamp bulbs. The patented Trap which is used to close the bottom opening and to lock in the lamp will outlast the life of fifteen lamps and effectively prevents their unauthorized removal. It can be renewed at trifling cost. Matthews' Holdfast Lamp Guards are made in five sizes and three weights. The only guard made that is approved by all the fire underwriters. **The only guard made that is absolutely guaranteed for ten years. Write for guarantee.**

NET QUANTITY PRICES, F. O. B. OUR FACTORY AT ROCKFORD, ILL.

Code Words	Trade Nos.	Size of Wire	Less than 1 dozen	1 dozen, less than 6 dozen	6 dozen, less than 12 dozen	1 gross, less than 5 gross	5 gross or more
GUARDS FOR PROTECTING 6, 8, 10, 16 C. P. CARBON AND 15, 25 WATT MAZDA LAMPS							
Cage	*117	17 b. w. g.	Per dozen \$2.10	Per dozen \$1.80	Per dozen \$1.65	Per gross \$18.00	Per gross \$16.20
Clasp	114	14 b. w. g.	2.35	2.05	1.90	21.00	19.20
Clinch	112	12 b. w. g.	2.85	2.55	2.40	27.00	25.20

GUARDS FOR PROTECTING 32 C. P. CARBON, 40 AND 60 WATT MAZDA LAMPS.

Close	*317	17 b. w. g.	Per dozen \$2.35	Per dozen \$2.05	Per dozen \$1.90	Per gross \$21.00	Per gross \$19.20
Clutch	314	14 b. w. g.	2.60	2.30	2.15	24.00	22.20

GUARD FOR PROTECTING 50 C. P. CARBON AND OLD TYPE 60 WATT MAZDA LAMPS

Compact	*514	14 b. w. g.	Per dozen \$2.85	Per dozen \$2.55	Per dozen \$2.40	Per gross \$27.00	Per gross \$25.20
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GUARDS FOR PROTECTING 100 AND 150 WATT MAZDA LAMPS

Complete	*714	14 b. w. g. (100 watt)	Per dozen \$6.00	Per dozen \$5.40	Per dozen \$4.95	Per gross \$53.40	Per gross \$48.60
Commend	814	14 b. w. g. (150 watt)	6.25	5.65	5.25	56.40	51.60

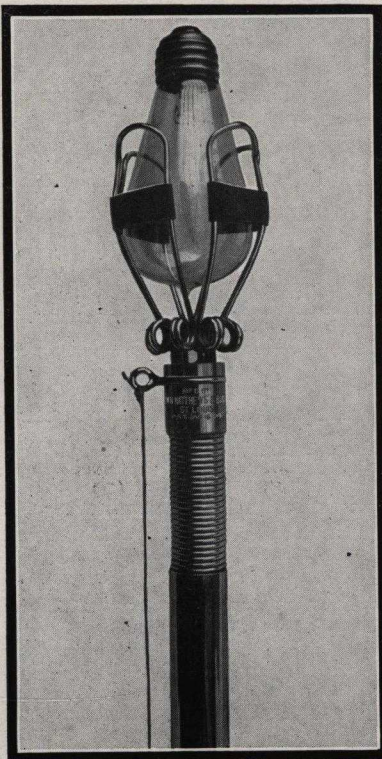
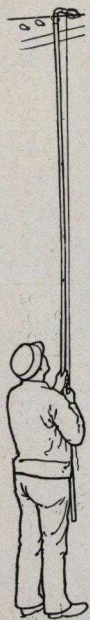
All guards will be furnished with a trap to prevent the unauthorized removal of lamps.

NET PRICES FOR EXTRA TRAPS FOR RENEWAL PURPOSES

Clever	None	16 b. w. g.	Per dozen \$0.20	Per dozen \$0.20	Per gross \$2.00	Per gross \$1.80	Per gross \$1 60
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*The letter "B" should be added after the trade number if guards for brass sockets are desired and the letters "WP" if wanted for weatherproof or porcelain sockets. Add the letters "D" or "ED" to the code words if guards for weatherproof or porcelain sockets are desired. Will fit all locking sockets. See pages 132 and 133.

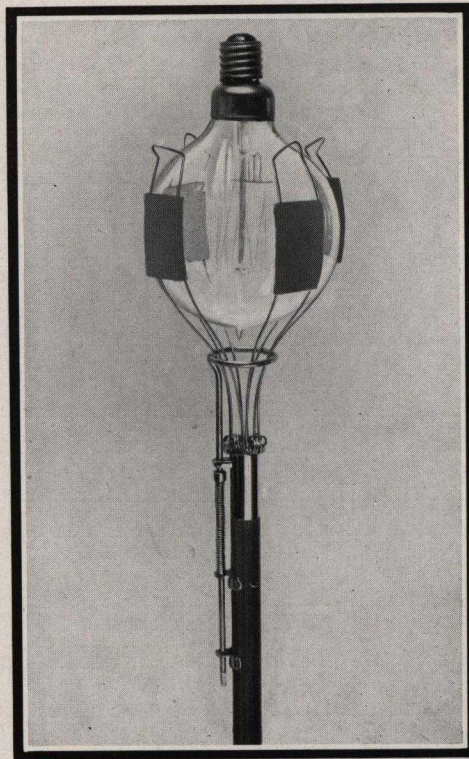
Prices are the same for brass or weatherproof socket guards. Collars for brass sockets 1¼ inches diameter; for weatherproof socket guards 1½ inches diameter. Freight, not to exceed 50 cents per 100 pounds, allowed on five gross or more in single shipments. F. O. B. Rockford, Ill. If traps are wanted for No. 714 or No. 814, please so specify, as they are a little larger than the others.



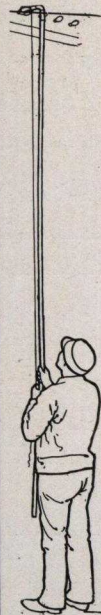
Numbers 1, 2 and 3



Don't let your men take this risk.



Number 4



MATTHEWS EASY LAMP CHANGERS

Invented by Allen T. Speelman and Oscar C. Watz—Patent Number 750108—Patents Pending

Matthews' Easy Lamp Changers are made in four sizes. The Nos. 1, 2 and 3 are provided with a flexible "wrist," so that they can be manipulated to remove or replace lamps at any angle. They fit carbon lamps from 2 to 50 candle power and Mazda lamps from 1 watt to 150 watts. A glance at the photograph opposite will show that the Nos. 1, 2 and 3 Matthews' Easy Lamp Changers are as nearly like the human hand and wrist as possible. Central Stations should furnish them free to users of decorative lamps, so that they will change their dead lamps immediately. The increased use of current will pay for the gift many times each year.

The No. 4 Matthews' Easy Lamp Changer is a new addition to this line of money savers. It differs from the others in several ways. Its "wrist" is rigid, not flexible. This is because it is designed to remove and replace lamps from 100 watts to 500 watts in size. These sizes are nearly always hung in a vertical position, therefore a rigid "wrist" is desired. These lamps are quite heavy and therefore it was necessary to provide means for holding them securely while they were held by the changer. This has been accomplished by means of the ring which compresses the fingers after they have been slipped over the lamp. By pulling down on the chain the fingers are released, so that they will easily slip over the lamp or can be easily removed therefrom. The ring springs back in clamping position when the chain is released.

The No. 4 Matthews' Easy Lamp Changer is going to be of particular interest to Central Stations that operate street series Mazda lamps and White Way fixtures.

SAFETY FIRST

Don't let your men climb up on ladders, boxes, etc., to change lamps. It is dangerous. Matthews' Easy Lamp Changers prevent broken bones and law suits that follow. They will reach all lamps that are not over 25 feet above the feet of the user.

NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.

Code Words	Trade Numbers	Description	Shipping Weights*	Less than 6, each	6 to 11, each	12 or more each
Radial	No. 1	For sign lamps from 1½ to 2½ inches in greatest diameter.	14 oz.	\$2.50	\$2.35	\$2.10
Rapid	No. 2	For 6 to 16 c. p. carbon lamps and 15 to 60 watt Mazda lamps	14 oz.	2.50	2.35	2.10
Rational	No. 3	For 32 to 50 c. p. carbon lamps and 100 to 150 watt Mazda lamps	18 oz.	3.00	2.85	2.60
Remarkable	No. 4	For 100 to 500 watt Mazda lamps and other lamps up to 8 inches outside diameter.....	40 oz.	5.00	4.75	4.30

*Shipping weights mean boxed for shipment. Parcel post, consider fractions over a pound as pounds, i. e., 1½ pounds=2 pounds.

No poles furnished by us. These can be obtained from any house-furnishing store. Ask for curtain pole 1 inch in diameter. Sent by parcel post unless otherwise specified. Postage extra.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



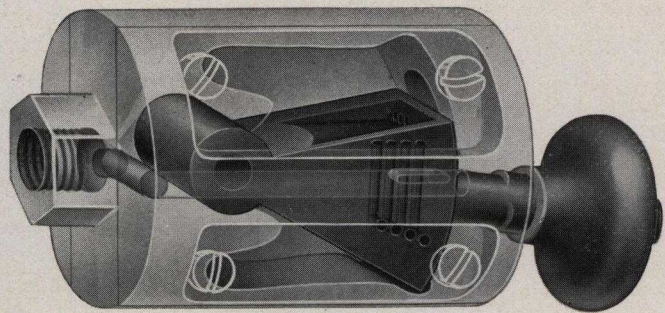


Figure 1

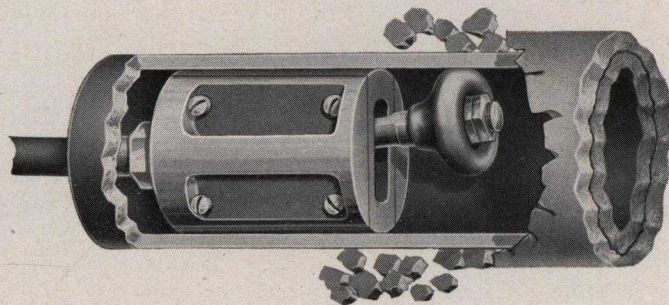


Figure 2

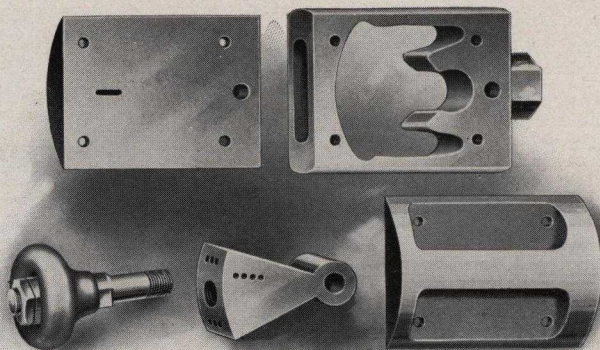


Figure 3

MATTHEWS SCALE KNOCKERS

Invented by Gustav C. Quasebarth—Patent Number 770313

Matthews' Scale Knocker does just that which its name implies: Knocks scale. It is operated by air or steam pressure. It will free a fire tube or water tube boiler from its scale in quicker time than any other device on the market. It does not remove it gradually or partially, but immediately and completely. The savings that are effected by its use commence as soon as you fire up the boiler after knocking off the scale.

CONSTRUCTION AND OPERATION

Reference to Figures 1 and 3 on the page opposite will show how it is constructed and that it has but five parts. It will also be seen that it is a valveless machine and therefore that the wear and possibility of getting out of order are practically negligible.

Figure 2 shows clearly what it will do.

Matthews' Scale Knocker is so carefully built and its design so efficient that we do not hesitate to say that it is the best and the most economical machine for the purpose that has ever been designed. Sent on ten days' free trial if desired. See proposition on page 5. We particularly want those who are regular users of boiler compounds to try one.

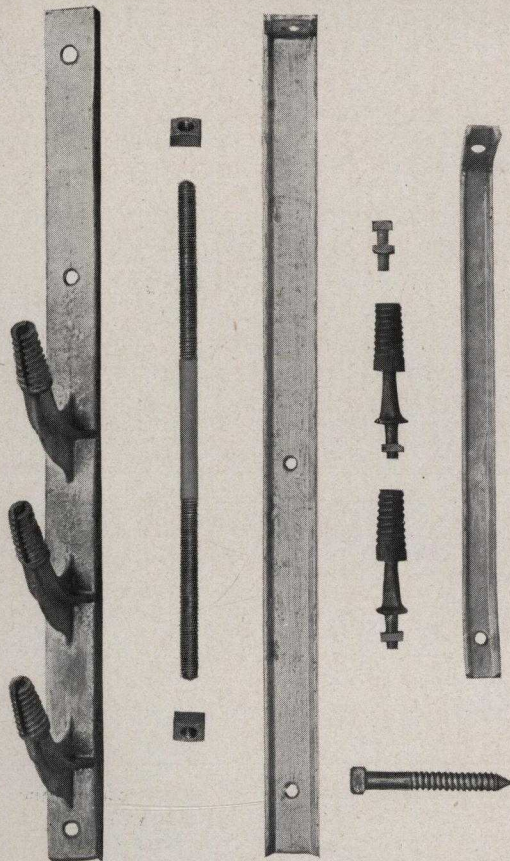
NET PRICES, F. O. B. ST. LOUIS, MO.

Code Words	Trade Numbers	Description	Net Prices
Scientific	No. 1	For 3 inch tubes.....	\$50.00
Safety	No. 2	For 3½ inch tubes.....	50.00
Saver	No. 3	For 4 inch tubes.....	50.00
Safeguard	No. 4	For 4½ inch tubes.....	60.00
Satisfaction	No. 5	For 6 inch tubes.....	70.00
Strong	No. 6	Hammer heads.....	.50
Strength	No. 7	Hammer head for fire tube boiler.....	.50

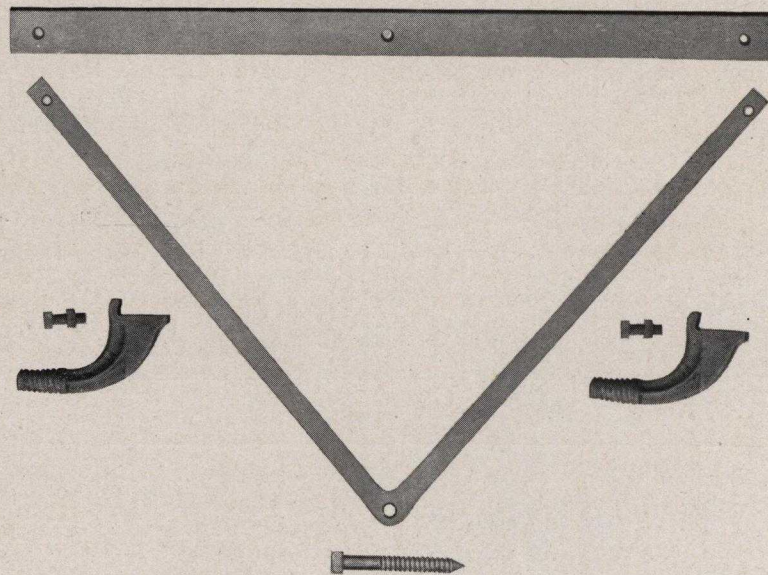
NOTE.—Boiler tubes are always measured by their outside diameter. The same machine can be used in either fire or water tube boilers with tubes of the same diameter. It is only necessary to change the hammer heads. Attachments can be furnished that will make it possible to use the same machine in tubes of different size, provided the difference in size is not too great. Not practicable for use in water tube boilers where scale is over 3/16-inch thick.

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Parts of Section 1



Parts of Section 2



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

MATTHEWS PRISECTIONS

Invented by John L. Fay—Patents Pending

Matthews' Prisections are a new departure in pole line hardware. They have a great many features that will appeal to the practical Central Station Operator.

PRISECTIONS is a coined word. Its meaning will be quickly seen: PRI=Primary; SEC=Secondary; SECTIONS=Sections. Primary-Secondary Sections. Some have said that it resembles the sectional bookcase because you can add sections as they are needed without much additional cost.

Their installed cost is wonderfully low. Turn to pages 43 and 45 and you will see how their installed cost was less than the old method by \$62.71 on two installations of fifteen poles where the Matthews' Prisections were installed in a private alley full of shade trees and the old scheme of primary and secondary wooden cross arms was installed on an open street with no obstructions and no property rights to respect. They are fine for Joint Pole Construction.

NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO.

Quantity	Section One Complete per 100	Section Two Complete per 100	Quantity	Section One Complete per 100	Section Two Complete per 100
Less than 1,000.....	\$250.00	\$235.00	5,000 and over.....	\$200.00	\$190.00
1,000 to 5,000.....	225.00	210.00	Weights.....	19 lbs.	19 lbs.

NET QUANTITY PRICES, F. O. B. ST. LOUIS, MO., ON SEPARATE PARTS SHOWN ON OPPOSITE PAGE

Telegraph Code Name.	Weight Pounds.	Description.	Material.	Less than 1,000 per 100.	1,000 to 4,999 per 100.	5,000 and over per 100.
Parts for Section 1						
UNOBTRUSIVE.....	6½	Primary Arm.....	Channel Iron.....	\$ 70.00	\$ 63.00	\$ 57.00
UTILITARIAN.....	2	Brace for Above.....	Channel Iron.....	30.00	27.00	24.00
UNEQUALED.....	9	Secondary Rack.....	Malleable Iron.....	150.00	135.00	122.00
USEFUL.....	¾	W. U. Pins.....	Wrought Iron.....	10.00	9.75	9.50
UTMOST.....	4	{ Extension for Primary Arm. }	Channel Iron.....	50.00	45.00	41.00
Parts for Section 2						
UNIQUE.....	4	V Brace.....	Bar Iron.....	\$ 60.00	\$ 54.00	\$ 49.00
UNIFORM.....	11	Transformer Arm.....	Bar Iron.....	120.00	108.00	97.00
ULTIMATE.....	2	Pins.....	Malleable Iron.....	35.00	32.00	29.00

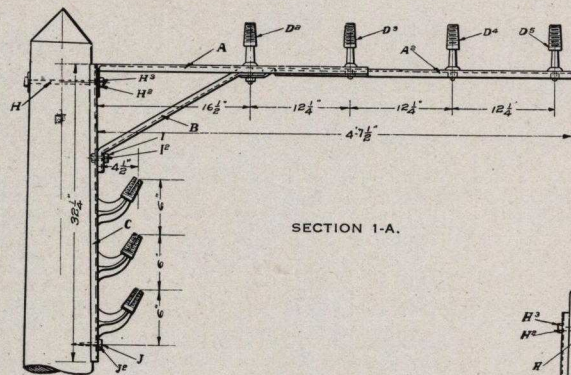
MISCELLANEOUS MATERIAL TO GO WITH SECTIONS 1 AND 2

Material.	Less than 1000, per 100	1000 to 4999, per 100	5000 and over, per 100
5/8"x12" Stud Bolts.....	\$6.00	\$5.75	\$5.50
3/8"x 2" Machine Bolts.....	3.25	3.00	2.75
5/8"x 5" Lag Screws.....	3.50	3.25	3.00

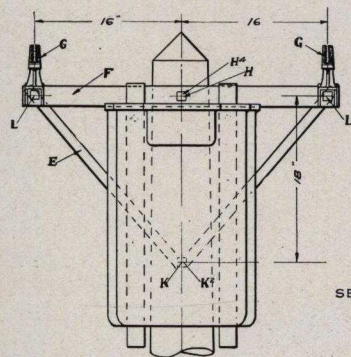
Any of the miscellaneous material can probably be bought locally at equal prices to those quoted above. All of this material is zinc coated and will stand A. T. & T. tests.

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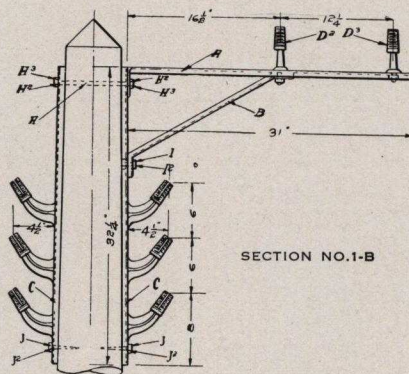




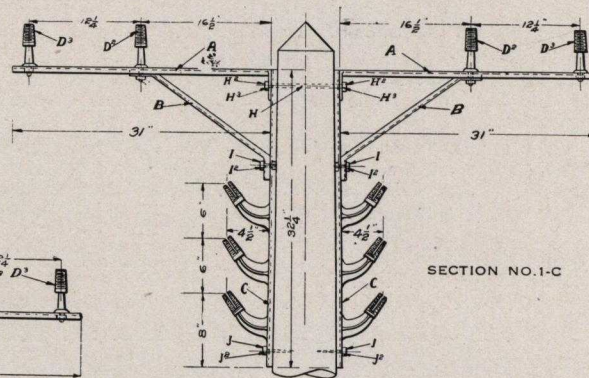
SECTION 1-A.



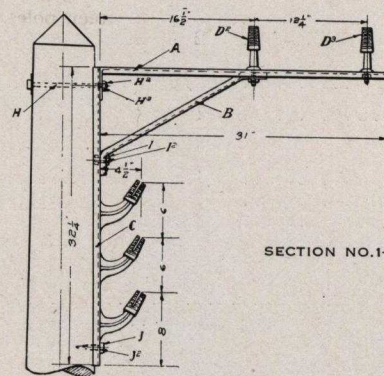
SECTION NO.2—



SECTION NO.1-B



SECTION NO.1-C



SECTION NO.1—



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DETAILED DESCRIPTION OF MATTHEWS PRISECTIONS

Section 1

Shows Matthews' Prisections in detail. They are constructed as follows: The secondary rack C is a malleable casting, the base of which is channeled. On this base three pins are cast (not riveted). These pins hold the insulators on which the secondary wires are supported. It will be seen that the top of this secondary rack C extends upward and has a hole H² cast in it. Through this hole the stud bolt H passes.

The channel iron primary arm A is bent down at an angle of 90° in the shape of an L on the pole end and has a hole H³ bored through it, which coincides with the hole H² in C when in its correct position. The stud bolt H also passes through this hole and serves to "tie" the two together and holds them securely to the pole.

The channel iron brace B is fastened to C by means of the $\frac{3}{8}$ "x2" machine bolt I or by means of a lag screw which fits in the hole I². The other end of the brace B is fastened to the primary arm A by means of the insulator pin D². This pin is a standard wrought iron Western Union pin re-threaded to act as a bolt.

The hole J² in C is to accommodate a $\frac{5}{8}$ "x5" lag screw J or a $\frac{5}{8}$ " through bolt, preferably the former.

The channel iron primary arm A is so designed that if it is desirable to have four pins on it, it is only necessary to remove the nuts from the lower end of the insulator pins D and attach the extension A² to the channel arm, using the pins D² and D³ as bolts. (See Section 1-A.)

Section 2

Shows an addition to Section 1 for supporting a transformer. It shows a phantom of the transformer in position. It consists of the transformer arm F made of bar iron; the malleable pins G, which support the wires leading to the transformer; the V brace E and the $\frac{5}{8}$ "x5" lag screw K or a $\frac{5}{8}$ " through bolt, preferably the former.

It will be seen that the stud bolt H used in Section 1 for supporting that structure can also be used for the main support of Section 2. The only operation necessary is to back off the nut and pass the bolt H through the hole H⁴ in the cross arm F.

It will also be seen that the bolts L are used for the double purpose of holding the pins G in place and for attaching the V brace E to the cross arm F.

The lag screw K is driven into the pole after passing it through the hole K² in the V brace E.

Section 1-A

Shows the same scheme as that shown in Section 1 with the addition of the primary extension arm A² providing for four primary wires.

Section 1-B

Shows method of providing for more secondary wires or drop loops by using the additional secondary rack C. It will be noted that this is held in position by the stud bolt H and a lag screw the same as J or K.

Section 1-C

Another modification of Section 1 is shown here. It is an exact duplication of Section 1 on the opposite side of the pole.

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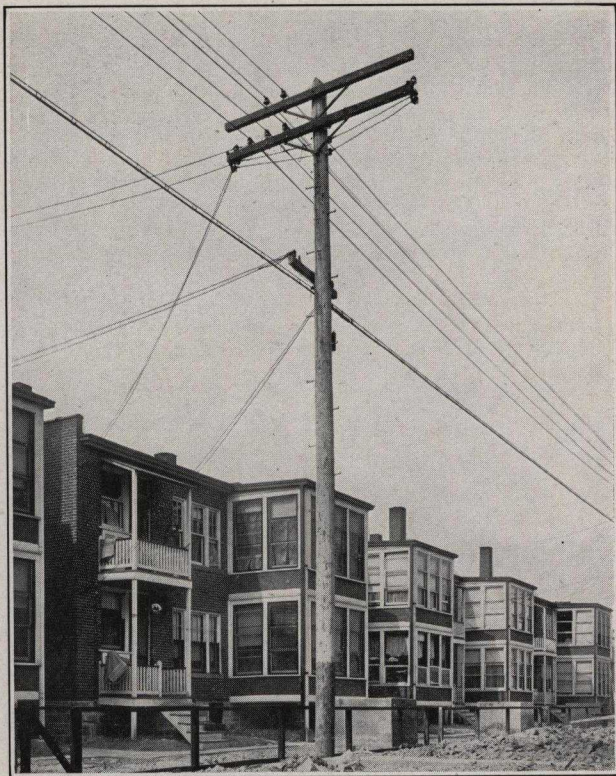


Figure 1

Showing typical old-style (1913) Primary Secondary Distribution Scheme. This is about as neat as this kind of work can be.

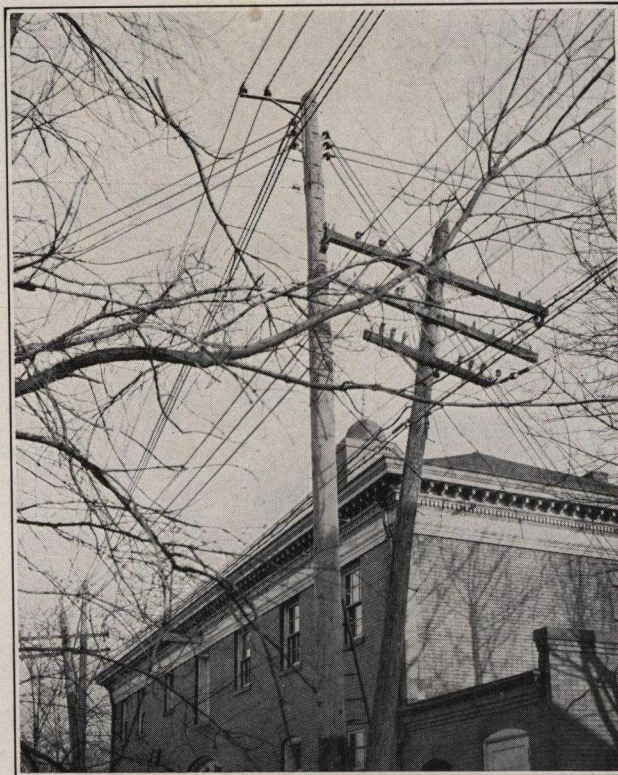


Figure 2

Showing Matthews Prisections and old pole line that they are to replace. Is there any wonder that the property owners demand this when they see it?

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



COMPARISON OF OLD PRIMARY AND SECONDARY CROSS-ARM METHOD OF DISTRIBUTION WITH MATTHEWS PRISECTIONS

Here are some figures which will show you the advantage of using Matthews' Prisections better than anything we can say. They were obtained from a prominent lighting company and were the result of a competitive test. The fifteen poles using Matthews' Prisections were set in a private alley between Westmoreland and Portland Places in St. Louis. (Photograph on page 44 shows character of residences.) All material had to be carried around lawns and over fences. Shade trees were abundant. Total cost, \$43.32.

The other fifteen poles, using the old scheme of primary-secondary distribution (see photograph on page 42), were set in an open street. No shade trees; no hedges or fences to climb; no lawns to avoid; conditions ideal. Total cost, \$106.03.

Saving by using Matthews' Prisections = \$4.18 per pole or \$32.71 for fifteen poles.

This is exclusive of wire and poles.

PRIMARY-SECONDARY ARM CONSTRUCTION

Primary Arm			Secondary Arm		
Material.	Quantity.	Totals.	Material.	Quantity.	Totals.
Primary Cross Arm.....	15	\$10.00	Secondary Cross Arm.....	15	\$10.00
24" Cross Arm Braces.....	30	3.855	24" Cross Arm Braces.....	30	3.855
5/8"x12" Machine Bolts.....	15	.675	5/8"x14" Machine Bolts.....	15	1.05
5/8"x5" Lag Screws.....	15	.34	5/8"x5" Lag Screws.....	15	.34
No. 72 Pins.....	15	3.00	No. 70 Pins.....	30	3.375
No. 580 Clamps.....	15	2.40	No. 581 Pins.....	15	2.25
No. 72-B Pins.....	15	6.00	No. 581-B Pins.....	15	3.08
Square Washers.....	30	.27	Porcelain Insulators.....	135	6.75
			Tie Wires.....	135	2.70
		\$26.54	3-Point Spreaders.....	30	9.30
			Malleable Pole Bracket.....	15	5.00
			2"x1/4" Lag Screws.....	60	.35
					\$48.05
Labor.	Hours.	Totals.	Labor.	Hours.	Totals.
Foreman.....	1 1/2	\$ 0.78	Foreman.....	1 3/4	\$ 0.91
Three Linemen.....	1 1/2	2.25	Three Linemen.....	1 3/4	2.625
Apprentice Lineman.....	1 1/2	.56	Apprentice Lineman.....	1 3/4	.656
Groundman.....	1 1/2	.45	Groundman.....	1 3/4	.525
Apprentice Groundman.....	1 1/2	.42	Apprentice Groundman.....	1 3/4	.492
Automobile.....	1 1/2	.65	Automobile.....	1 3/4	.766
		\$ 5.11			\$ 5.97
Total.....		\$31.65	Total.....		\$54.02

Primary Arm, \$31.65 + Secondary Arm, \$54.02 = \$85.67.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





Forward from page 43\$ 85.67

Extra Team to Haul Arms for this Job

Labor.	Hours.	Totals.	
Driver.....	21	\$ 6.30	
Team.....	21	7.14	\$ 13.44

Fitting Up Thirty Cross Arms

Labor.	Hours.	Totals.	
Man Fitting Up 2-Pin No. 72.....	2	\$ 0.35	
Man Fitting Up 3-Pin No. 70.....	3	.53	\$ 0.88

Grand Total for Fifteen Poles.....\$106.03

Material Used to Paint Thirty Cross Arms

One Coat Lead and Oil Paint.

Material.	Quantity.	Totals.	
White Lead in Oil.....	10 Pounds.	\$ 0.68	
Boiled Linseed Oil.....	1½ Gallons.	.83	
Turpentine.....	½ Gallon.	.28	
Japan Drier.....	¼ Pint.	.02	
Dry Red Mineral.....	4½ Pounds.	.11	\$ 1.92
Man to Paint.....	2½ Hours.	0.44	
Freight.....		3.68	

Material.	Matthews Prissections	Quantity.	Totals.	
Matthews Prissections (Section 1).....		15	\$37.50	
5/8"x12" Stud Bolts.....		15	.675	
Square Washers.....		30	.27	
5/8"x5" Lag Screws.....		15	.34	\$38.79
Labor.		Hours.	Totals.	
Foreman.....		2	\$ 1.04	
Lineman.....		2	1.00	
Groundman.....		2	.56	
Automobile.....		2	.875	\$ 3.48
Freight.....			1.05	
Grand Total.....			\$43.32	

Total cost of primary secondary scheme formerly used by above mentioned company (conceded by many to have been as efficient as any in existence)\$106.03

Total cost of handling same number of wires on same number of poles under very much more difficult conditions, using Matthews' Prissections. 43.32

Difference in favor of Matthews Prissections.....\$ 62.71

Profit to above mentioned company on their investment of \$43.32 in Matthews' Prissections for these fifteen poles is, therefore, equal to \$62.71 or 145%.

If Matthews' Prissections were purchased in 5,000 lots the investment on the above would have been \$35.72 and the profit 196%.

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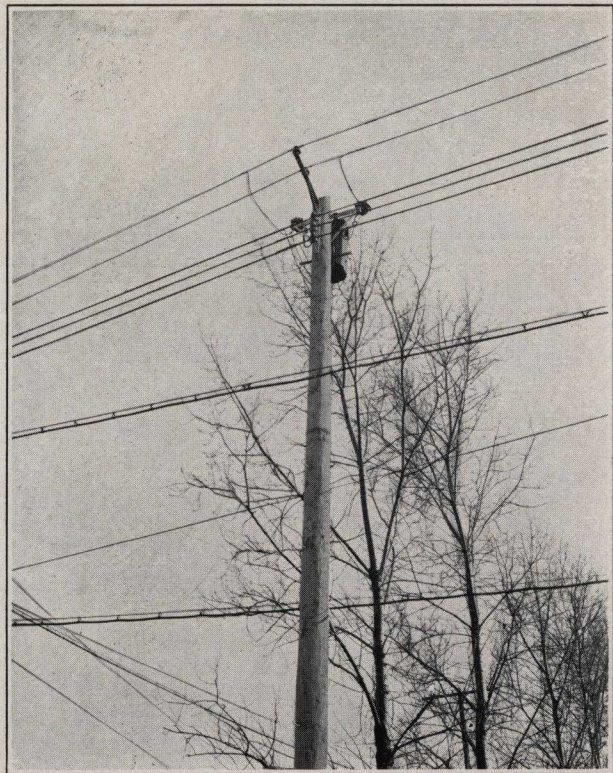


Figure 3

Showing Matthews Prisections Section 1 in combination with Section 2. All held to pole with one through bolt and two lag screws.

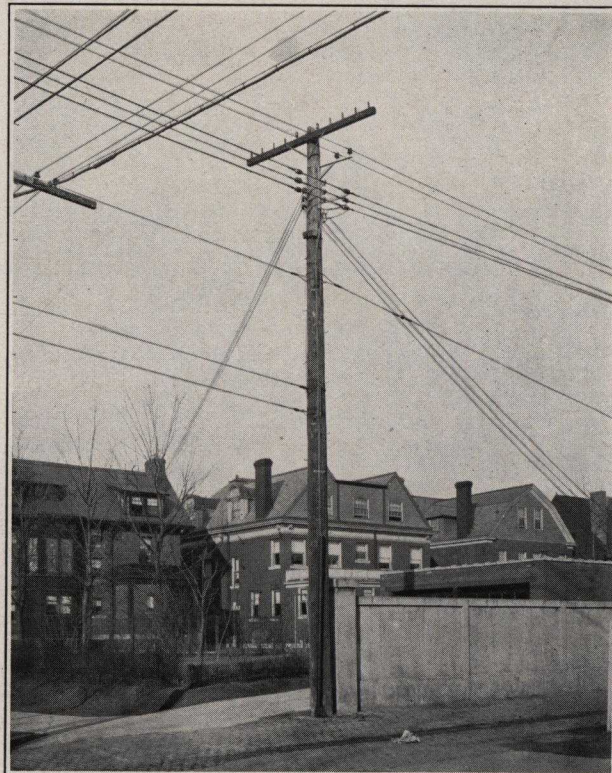


Figure 4

Showing Matthews Prisections with additional secondary pins for service drops. (See Section 1B.) Kinloch Telephone Co. wanted top gain for their wires.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

COMPARISON WITH OTHER METHODS OF PRIMARY-SECONDARY CROSS-ARM CONSTRUCTION

It is realized that for the purposes of comparison, the figures quoted on pages 43 and 45, may be confusing to those who do not use the same material. For example the following items in their list of material are patented specialties which are not used by all companies: No. 70 pins; No. 72 pins; No. 72-B pins; No. 580 clamps; No. 581 pins; No. 581-B pins. These specialties do away with the boring of pin holes in the cross arms and are designed to prevent the cross arms from splitting due to weather cracks. They may be seen in the photograph on page 42 at the left.

Because of the above we give below what we believe to be a conservative estimate of the cost of the primary and secondary cross arm method of distribution for comparison with the figures quoted on pages 43 and 45.

PRIMARY CROSS ARM AND FITTINGS. (FOR ONE POLE)

Material.	Totals.
1 8-Pin Cross Arm.....	\$0.60
1 $\frac{5}{8}$ "x12" Machine Bolt.....	.045
2 $\frac{5}{8}$ " Square Washers.....	.018
2 $\frac{1}{2}$ "x4 $\frac{1}{2}$ " Carriage Bolts.....	.043
4 $\frac{1}{2}$ " Round Washers.....	.0104
1 $\frac{5}{8}$ "x5" Lag Screw.....	.0224
2 28" Slab Braces.....	.236
2 Locust Pins.....	.026
	\$1.0008

Labor

Time.	Totals.
Lineman.....20 minutes.	\$0.1666
Groundman.....20 minutes.	.10
Team.....7 minutes.	.0371
	\$.3037

Total Primary Arm..... \$1.3045

To the above should be added the cost of painting—16c. and extra team to haul arms to job—90c., which would be approximately the same as that shown on page 45, and the freight—25c..... \$1.31

Grand Total..... 5.9483

Cost of Matthews' Prisections to perform the same work as shown on page 45 is \$43.32÷15=\$2.89..... 2.89

Total Saving..... \$3.06

Profit to purchaser of Matthews' Prisections on their investment of \$2.89 is therefore equal to \$3.06 or 109%.

It will be noted above that we have substituted for the 66 $\frac{2}{3}$ -cent cross arms used in the first example a 60-cent cross arm.

If right angle or buck arm work is used for service connections, then the cost would be slightly higher because of the extra cross arm braces, bolts, etc., and the labor necessary to attach the right angle cross arm and the saving effected by Matthews' Prisections would be even greater.

SECONDARY CROSS ARM AND FITTINGS. (FOR ONE POLE)

Material.	Totals.
1 8-Pin Cross Arm.....	\$0.60
1 $\frac{5}{8}$ "x12" Machine Bolt.....	.045
2 $\frac{5}{8}$ " Square Washers.....	.018
2 $\frac{1}{2}$ "x4 $\frac{1}{2}$ " Carriage Bolts.....	.043
4 $\frac{1}{2}$ " Round Washers.....	.0104
1 $\frac{5}{8}$ "x5" Lag Screw.....	.0224
2 28" Slab Braces.....	.236
3 Locust Pins.....	.039
9 Porcelain Insulators.....	.45
9 Tie Wires.....	.18
1 3-Point Pole Bracket.....	.33
2 3-Point Spreaders.....	.62
4 $\frac{1}{4}$ "x2" Lag Bolts.....	.06
	\$2.6538

Labor

Time.	Totals.
Lineman.....45 minutes.	\$0.375
Groundman.....45 minutes.	.225
Team.....15 minutes.	.08
	\$0.68

Total Secondary Arm..... \$3.3338

Total Primary Arm..... 1.3045

\$4.6383

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



COMPARISON OF SECTION TWO AND OLD METHOD

The method of attaching Section 2 of Matthews' Prissections is described on page 41. The only extra piece needed for holding this rack is a $\frac{5}{8}$ "x5" lag screw to hold the V brace E to the pole. If a through bolt is used on Section 1 in place of the lag screw J, the additional lag screw will not be needed, as the through bolt can be used for both lag screws.

In less than 1,000 lots assorted, Section 2 costs, each.....

\$2.35

Labor

Lineman.....
Groundman.....
Team.....

Time
10 minutes.
10 minutes.
10 minutes.

Totals
\$0.0833
.05
.053

\$0.1863

TRANSFORMER CROSS ARMING. DOUBLE CROSS ARMS

Grand Total, \$2.5363

Material	Totals
2 5-Pin Arms.....	\$1.20
1 4-Pin Arm.....	.40
2 $\frac{5}{8}$ "x14" Machine Bolts.....	.10
4 $\frac{5}{8}$ " Square Washers.....	.036
3 $\frac{5}{8}$ "x5" Lag Screws.....	.0672
6 28" Cross Arm Braces.....	.708
5 Locust Pins.....	.065
12 $\frac{1}{2}$ " Round Washers.....	.0312
6 $\frac{1}{2}$ "x4 $\frac{1}{2}$ " Carriage Bolts.....	.1290
	<u>\$2.7364</u>

Labor
Lineman.....
Groundman.....
Team.....

Time
30 minutes.
30 minutes.
30 minutes.

Totals
\$0.25
.15
.16

\$0.56

Grand Total..... \$3.2964

Cost of Section 2 installed..... 2.54

Net Saving..... \$0.76

Profit on investment in Section 2.....30%

Total cost of handling by the old method the same thing that can be accomplished by Sections 1 and 2 of Matthews' Prissections is, as shown on page 47.

For Primary Arm Installed. (See page 47).....	\$1.31
For Secondary Arm Installed. (See page 47).....	3.33
Hauling Primary and Secondary Arms, etc. (See page 47).....	.90
For Painting Primary and Secondary Arms. (See page 47).....	.16
For Transformer Cross Arming as shown above.....	3.29

Total..... \$ 8.99

Total cost of handling by Matthews' Prissections, Sections 1 and 2, is: For Section 1, \$2.89, and for Section 2, \$2.54.

Total..... \$ 5.43

Total Saving for Installation..... \$ 3.56

Profit on investment of \$5.43 = \$3.56 or 65%.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



RECAPITULATION

To sum it up, Matthews' Prestensions give a primary arm for horizontal distribution; secondary supports for vertical secondary distribution (Section 1) and a transformer rack (Section 2) all in combination, each with the other. The pins D are used as bolts to hold the brace B and the stud bolt H is assisted by the lag screws J and K which hold the secondary rack C and the V brace E at their lower portions. It will be seen that there is a decided difference in labor cost between Matthews' Prestensions and the older methods that does not appear in the figures given. Instead of having a multitude of parts to handle and assemble, Section 1 has only thirteen parts including bolts, nuts and washers. Section 2 has only seven parts including bolts and nuts. There are only four bolts to handle for both Sections 1 and 2 and only one hole to bore through the pole.

All prices on Matthews' Prestensions are figured on the less than 1,000 quantity. In fitting up wooden cross arms, it is necessary for linemen to bore holes in arms; attach braces and bolts; bore at least three holes through the pole; saw gains in the pole and do considerable carpenter work. All of this will add at least fifty cents (50c) to the figures on the older methods. In addition to this there will still be a large depreciation factor to consider. Wooden cross arms must be frequently changed because of splitting, dry rot, insect attacks, fractures, etc. Their life is usually seven to ten years.

Matthews' Prestensions offer very much less resistance to wind pressure than poles with regular wood cross arms. This increases life of pole and the line material.

The depreciation factor on Matthews' Prestensions is practically zero, because all of the parts are thoroughly zinc coated. This gives them an ultimate life equal to present up-to-date high power steel transmission line towers.

A further decided advantage that is possessed by Matthews' Prestensions is that if the growth of the city makes it necessary to change the overhead distribution system to underground, they can be used repeatedly in other localities. As a rule wooden cross arms are turned in as scrap or burned for firewood.

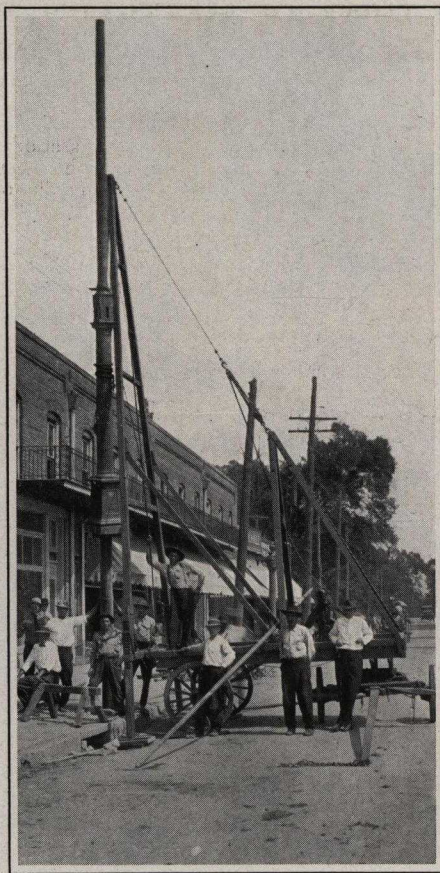
For joint pole construction Matthews' Prestensions are peculiarly well adapted. Their use will enable the lighting and telephone companies to get together on joint pole construction where they have been unable to agree heretofore. This is because of the fact that their use eliminates any objection which the lighting company may have to the position on top of the pole, where the telephone companies prefer them to be and at the same time Matthews' Prestensions do not take up any more room than the older methods of primary-secondary distribution. Furthermore, Matthews' Prestensions absolutely separate the primary wires from the secondary wires, thereby doing away with the necessity of pulling slack to prevent their coming together.

In horizontal construction the secondary wires cannot be strung closer together than about twelve inches, because the wind is likely to whip the wires together. When Matthews' Prestensions are used, the secondary wires are strung with a spacing of six inches. This is made possible because the spacing will at all times be uniform, the wires will slack equally and the wind cannot bring them together. Because of this closer spacing, the inductive drop in the secondary line is greatly reduced. This is an important item and although it cannot be figured out here in dollars and cents, every central station man will appreciate this advantage.

It will of course be appreciated that there will be ten of Section 1 used for every one of Section 2. It is remarkable to see the savings effected by Section 1 mounted up, when any number of poles are to be equipped. Just take the saving effected by Matthews' Prestensions and multiply it by 1,000 poles. This will give you $\$3.06 \times 1,000 = \$3,063.00$. This is enough saving to pay a 6% dividend on $\$53,000.00$ worth of your stocks. Even on 100 poles the saving is $\$306.00$ or enough to pay a 6% dividend on $\$5,030.00$ worth of your stocks. (See page 47.)

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.





These pictures were furnished by the Southern Public Utilities Co., Charlotte, N. C. See letter No. 5 on page 51.

WHAT THEY THINK OF MATTHEWS POLERECTOR

Number 1

CITY OF WINNIPEG, CANADA, April 1, 1914.

GENTLEMEN:

Acknowledging yours of the 27th of March, I beg to state that we have had entire satisfaction with your Polerector.

So far we have used it only on the erection of ornamental arc-lighting standards; these are steel pipe about thirty-five feet long with a cast iron base. It was necessary to erect the pole first and slip the base over the top after.

With a small outlay we placed four wheels under the Polerector and were able to move it along the street and erect the standards, using three men only.

We estimate that we saved 30 per cent of labor by using this Polerector.

We very gladly grant you permission to use this letter in helping others to decide in favor of using your machine.

Yours truly,

CAC/OM.

C. A. CLEMDERING,
Distribution Supt.

Number 2

HYDRO-ELECTRIC POWER COMMISSION.

TORONTO, ONTARIO, CANADA, March 31, 1914.

DEAR SIR:

We have used your Polerector on the construction of a wood line through Hamilton, Ontario, and found it very satisfactory for this city work. The Polerector has since been sold to the Toronto Hydro-Electric System.

Yours truly,

FRED K. A. GABY,
Chief Engineer.

Number 3

ELMIRA WATER, LIGHT & RAILROAD COMPANY.

ELMIRA, N. Y., April 1, 1914.

GENTLEMEN:

Replying to your letter of March 27th regarding the service which we received from your Polerector. Our Superintendent of Electrical Distribution writes that it was one of the greatest labor-savers that he has had on line work. He estimated that on some city work, on approximately one and one-half miles of sixty-foot poles, that it paid for itself, and that on some cross-country high tension work he gave it the hardest kind of service, handling sixty-foot poles on edges of ravines and rough land.

Yours very truly,

F. H. HILL,
Acting Gen. Mgr.

FHH/IS

Number 4

FITCHBURG GAS AND ELECTRIC LIGHT CO.

FITCHBURG, MASS., March 30, 1914.

GENTLEMEN:

The Matthews' Polerector purchased by us in 1910 was used largely for removing 55-foot poles along our main street. This work was very satisfactorily performed by the Polerector and we believe that considerable money was saved by its use.

Yours very truly,

FITCHBURG GAS & ELEC L'T CO.,
By C. R. Hayes, Manager.

CRH/J

Number 5

SOUTHERN PUBLIC UTILITIES CO.

CHARLOTTE, N. C., May 1, 1914.

GENTLEMEN:

In reply to your letter of April 15th, as to the Polerector, would say that we are very much pleased with the same. We purchased this erector for the purpose of raising combination steel trolley poles and ornamental lighting standards while building an ornamental system in this city. These poles consisted of 35-foot steel trolley poles with cast iron lighting fixture slipped over same, total weight being approximately 2,000 pounds. We were able to do this work with a driver, team and four extra men in the raising gang. Four men would not be necessary under ordinary conditions, but were used to handle the poles on the ground. We found the apparatus exceptionally convenient in places where there were aerial obstructions to contend with.

In removing old poles from service along the business street we were able to take down as many as nineteen in half a day, the greater number of same being 50-foot poles. These poles were loosened slightly at the ground line before pulling.

Yours very truly,

By W. W. HANKS.

SOME OF THOSE WHO USE IT.

Citizens' Electric Light & Power Co., Clifton Heights, Pa.
Consolidated Gas, Electric Light & Power Co., Baltimore, Md.
Chippewa Valley Railway, Light & Power Co., Eau Claire, Wis.
Sanitary District of Chicago, Chicago, Ill.
Meacham & Babcock, Seattle, Wash.
Presumpscott Electric Co., Portland, Me.
Atlantic Gas & Electric Co., Bangor, Pa.
Erie Lighting Co., Erie, Pa.
Rockford Electric Co., Rockford, Ill.
Florida Power Co., Ocala, Fla.

Number 6

OTTER TAIL POWER CO.

FERGUS FALLS, MINN., April 14, 1914.

GENTLEMEN:

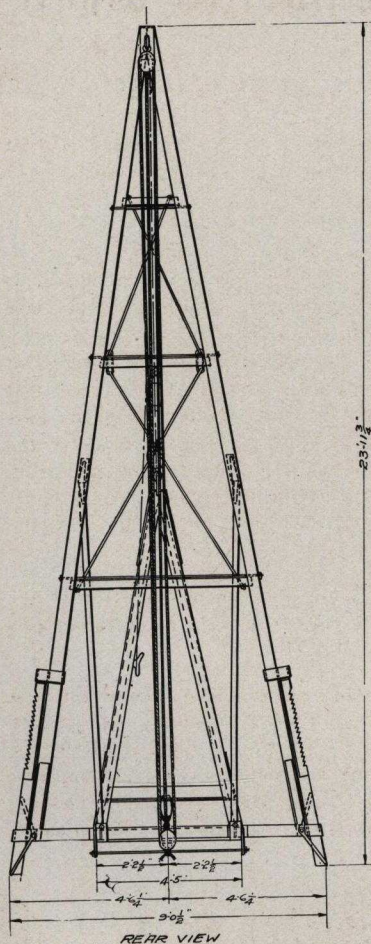
Replying to your favor of March 27th, in regard to the Matthews' Polerector which we bought of you in May, 1913. We used this erector last year in building about 110 miles of transmission line, mostly 40-foot poles. We are very well pleased, indeed, with this erector and think it saved us considerable money as well as time, and we consider it very much safer than raising poles with pikes. We have not used it for taking down old poles.

Yours very truly,

By C. B. KIDDER,
Manager.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.





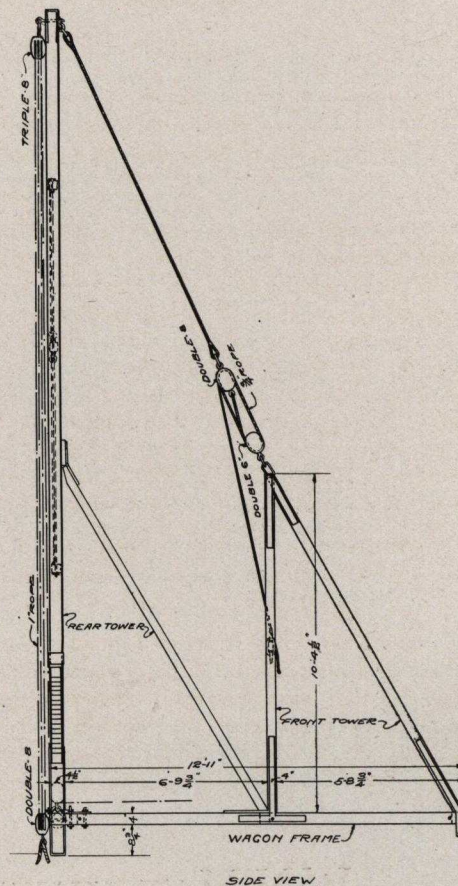
REAR VIEW



Showing overall dimensions of Matthews Polerector. Designed to fit standard 12-foot wagon bed.



MATTHEWS POLERECTOR



SIDE VIEW

THE USE OF A MATTHEWS POLERECTOR BY THE DEFENDANT IN THIS CASE WOULD PROBABLY HAVE PREVENTED THIS TRAGEDY AND LAWSUIT

LIABILITY TO LINEMAN KILLED WHILE ON A POLE BY AN ELECTRIC CURRENT

This was an action brought to recover damages for causing the death of a lineman owing to a shock received from an electric current off an iron brace in contact with a high-tension wire, from which the insulation had been worn, or it had never been properly insulated. In the court below the plaintiff recovered a verdict of \$7,500, and the defendant appealed.

(Court of Appeals Affirmed Verdict of Lower Court)

Deceased was in the service of defendant as foreman of a gang of men engaged in erecting electric poles. Two methods are commonly employed in raising them. One is to lift them by means of spike poles, and the other is, if they are being erected to take the place of old ones, to hoist them with block and tackle attached to the old pole. On the 12th of September, 1910, deceased was preparing to hoist a pole at the corner of Third avenue and Seventh street in the city of He ascended the old pole, which was equipped with a primary wire carrying 2,300 voltage, a transformer, and telephone wires, and had fastened the block and pulleys to the pole, just above the lower or third cross beam, and had begun to descend, when the defendant's general line foreman, who was standing near the foot of the pole, called to him that the "fall" line was not properly adjusted; that it should hang next to the pole, instead of on the outside of the block, as it was. Deceased then returned, adjusted the rope, and in descending the pole caught hold of one of the metal braces supporting the cross-arm. The brace being highly charged with electricity, and his body coming in contact with one of the telephone wires, a short circuit was formed, and he was killed. There was an uninsulated joint, 3 inches long, in the primary wire, which, by contact with the brace, caused it to become charged with a deadly current of electricity.

Workmen in climbing the pole were liable to come in contact with the exposed joint, and it was liable to come in contact with the brace. It was negligence to leave it in such a condition. It is a common practice among pole climbers to take hold of the metal braces, and, if the wiring is normal, there is no danger in doing so.

But non-liability is claimed on two grounds: (1) Assumption of risk, and (2) contributory negligence. The availability of the first defense depends upon the scope of deceased's employment. If he was employed to do any and all kinds of work in repairing an old line which he knew was abnormally dangerous, then he assumed the risk of all the dangers incident to that kind of work. If he knew the wires, as well as the poles, were out of repair, and was employed to put both in proper condition, while the current was on the wires, the cause of his death was one of the assumed risks, and plaintiff can not recover. If such was his knowledge and such the scope of his undertaking, he must have expected to encounter such danger as the one that caused his death.—Taken from the March, 1914, issue of "The Central Station."

W.N.MATTHEWS AND BROTHER, Inc. ST. LOUIS U.S.A.





THE WAY THEY SCREW
DOWN,
GAVE THEM WORLD
RENOWN



Ready to bore in.



Boring it in. No Digging.



Pole anchored in 20 minutes.



THE ANCHOR THAT
SCREWS,
IS THE ONE TO
USE

Figure 1

THE ANCHOR TO USE IS THE ONE THAT SCREWS

To those who do not know, Matthews' Guy Anchors, long known as "The Stombaugh," are the simplest and best form of pole anchors made. They are screwed into the solid ground in much the same manner as a corkscrew is screwed into a cork. The simplicity of construction, the absence of moving parts and the ease with which they can be installed makes them the most economical anchors that can be obtained.

EXCLUSIVE FEATURES

Matthews' Guy Anchors are the only anchors that are made in one piece. *The only anchors that have no moving parts to adjust or that might be carelessly buried unadjusted.* The only ones made that are screwed into the solid, undisturbed ground without digging. The only anchors made that your inspector can conscientiously O. K. after they have been installed without having been present at their installation. The only anchors made that can be installed under water (see page 62 and letter No. 8 on page 65) or in quicksand (see letter No. 9 on page 65) or dry, loose sand. The only anchors made that will almost invariably gain permission from property owners for their installation on private right-of-way because they are screwed down without digging (see page 61 and letters Nos. 3 and 4 on page 64). The only anchors made that can be easily recovered and which can therefore be used economically for temporary anchorages. Simply screw them out (see page 62). The only anchors made that have been continuously on the market with ever-increasing demand for fifteen years (see letter No. 27 on page 67).

THE MARATHON RUNNER AND THE HUNDRED YARD DASH MAN

The "competition" that the Matthews' Guy Anchor has had in its fifteen successful years on the market reminds us of the difference between the Marathon Runner and the Hundred Yard Dash Man. They decided to have a race for a mile. The H. Y. D. M. started off in great shape and passed the M. R., but the M. R. did not worry. He kept up his even, steady pace and very soon he passed the panting and nearly spent H. Y. D. M. at the half-mile post and came in so far ahead of his erstwhile competitor that it was necessary for the crowd to use field glasses to see said competitor.

Moral: Don't be fooled by H. Y. D. M. in this competition for your anchor business. You want an anchor that will be on the job for five, ten or fifteen years after you put it down. Matthews' Guy Anchors are the only ones that have been on the market long enough to demonstrate that they will stay put. Others will creep or wedge themselves out in time, even though they may hold great strains on initial tests. This can be proven (see letter No. 6, page 64; letters Nos. 18 and 20, page 66; letter No. 24, page 67). Use Matthews' Guy Anchors for light and medium strains. When you have very heavy strains don't use any patented anchor. Use a "dead man" that you know will hold.

The kind of strains they will hold and the places to use Matthews' Guy Anchors are suggested on the following pages.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



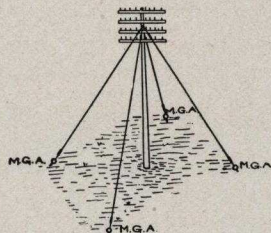


Figure 2

STORM GUY

Use No. 502R Matthews Anchors for side guys and No. 603R for line guys on toll lines, the ultimate capacity of which will not exceed 10 wires.

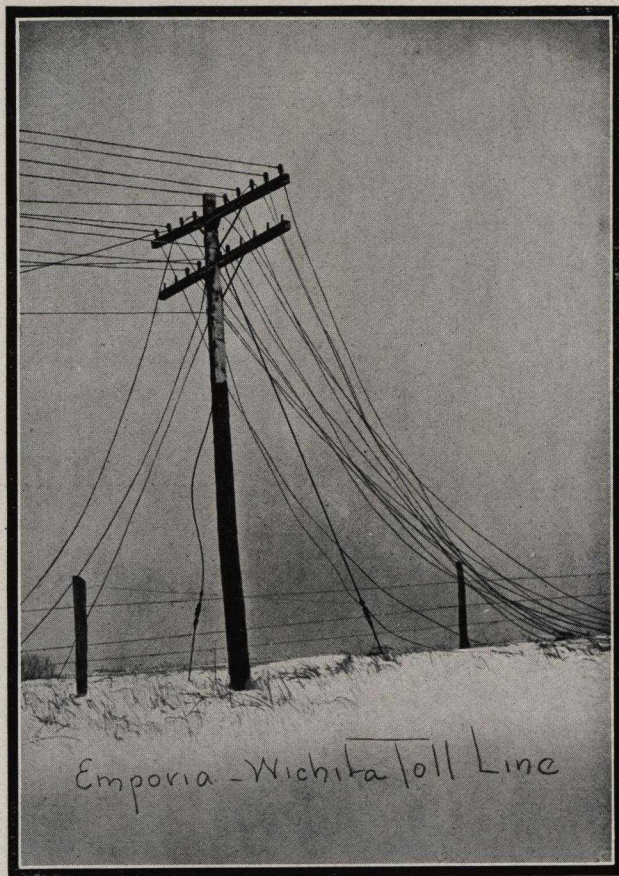


Figure 3

Saved by a No. 603R Matthews Guy Anchor. Anchor every tenth pole four ways in straight leads.
The immense value of storm guying can only be appreciated during a sleet storm.

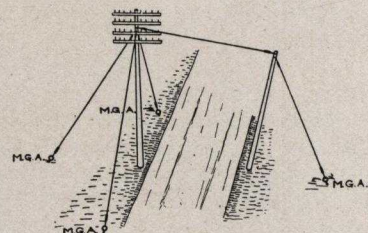


Figure 4

STORM GUY

Use No. 603R Matthews Anchors for side guys and No. 704R for line guys on toll lines, the ultimate capacity of which will not exceed 20 wires.





Figure 5

It would have been exceedingly costly to have put down a dead-man here, because of the close proximity of the brick sidewalk and the gas lamp.



Figure 6

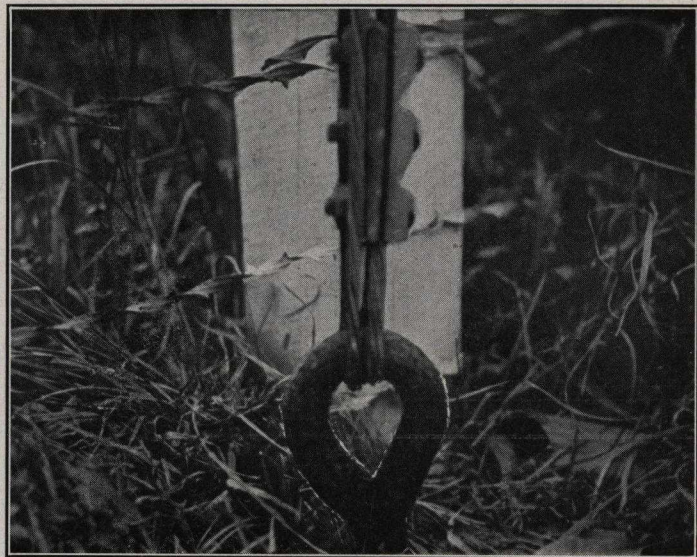


Figure 7

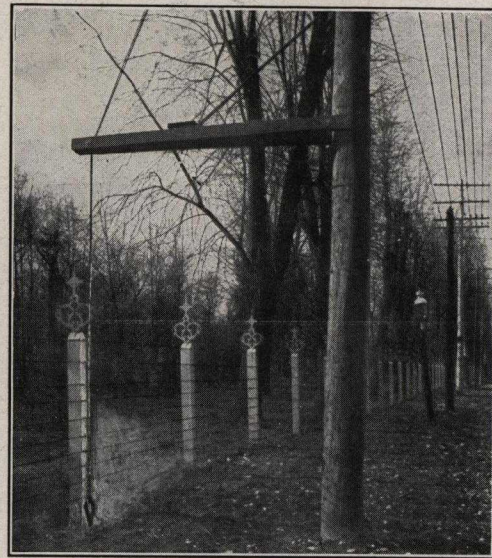
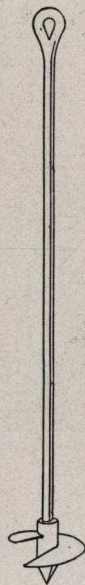
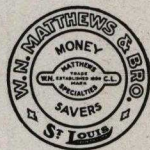
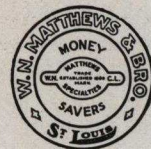
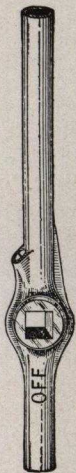


Figure 8



Shows one of the ten No. 800 Matthews Guy Anchors that made it unnecessary to move an important pole line across the street. Obdurate property owners refused permission to anchor inside the fence. Anchor was screwed down perpendicularly as close to the property line as possible. A truss arm was built out from the pole to clear guys from sidewalk and they were attached to the end of it.





**The 765
Ratchet
Handle**



Figure 9

Figure 10 shows two things: First, that the Matthews Guy Anchor can be screwed down in places where other forms of anchors would not be allowed; and second, that with the aid of a No. 765 Ratchet Handle they can be screwed down to the eye when inserted at sharp angles. This anchor is holding a corner pole at Delmar Garden, St. Louis, and was screwed down within twelve inches of one of the uprights supporting the scenic railway.

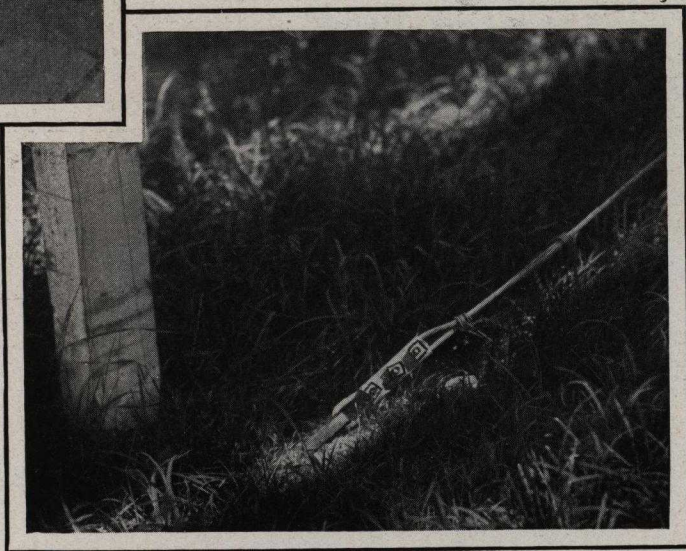


Figure 10



**The 765
Ratchet
Handle**

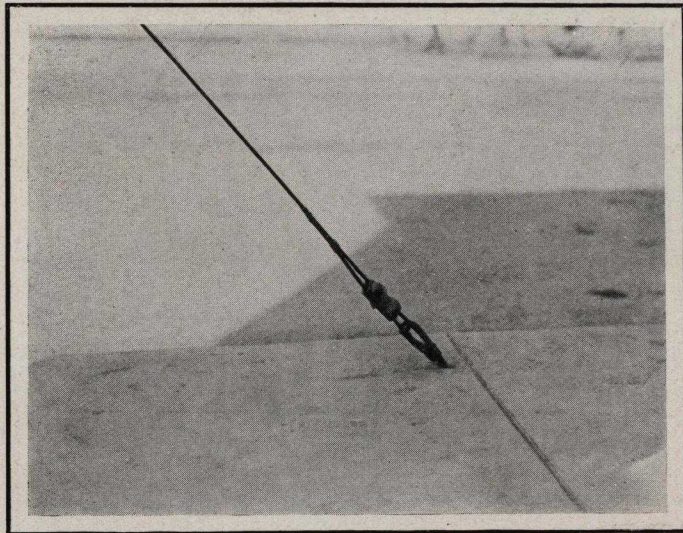


Figure 11

Do you think the property owners' consent could have been obtained if the construction gang had wanted to dig a hole in this flower bed? Not on your life, but it was easy when a six-inch Matthews Guy Anchor was offered to solve the difficulty. The consent was obtained in short order.

Here's a case where a six-inch Matthews Guy Anchor saved considerable money. A section of the sidewalk was chiseled out about eight inches in diameter. The anchor was then inserted and screwed down to its full depth. A small amount of granitoid was used to finish the job as shown.

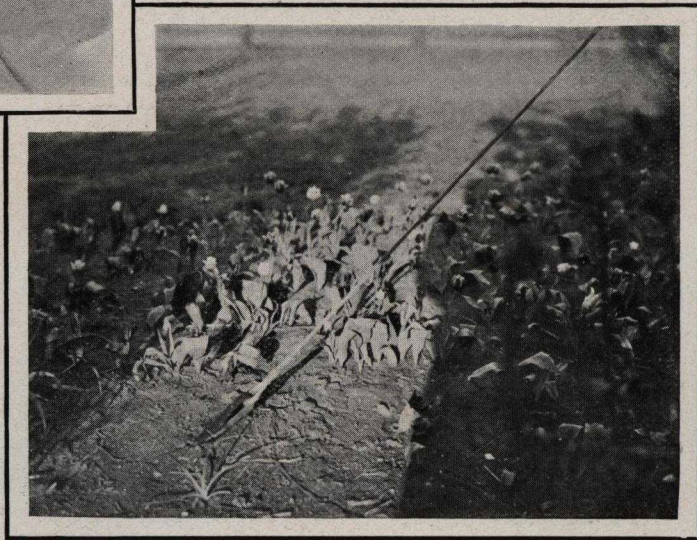


Figure 12



Figure 13



Figure 15

THE MAN WITH THE GUN

Once upon a time there was a pole-using company that needed an anchorage in private grounds. They told their men to try to get an anchor down there.

The men were just starting to dig a hole when the owner came out with a gun and started to drive them away.

The foreman telephoned the superintendent the condition of affairs.

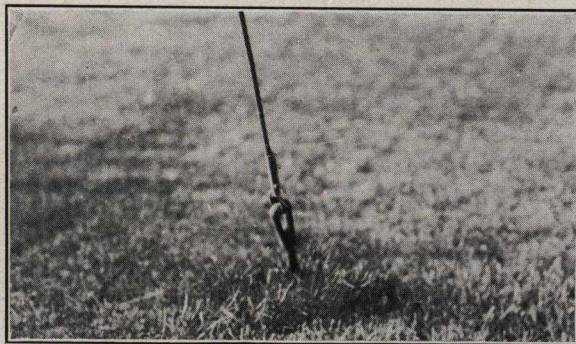


Figure 17

The superintendent rushed out in his auto with a Matthews Guy Anchor and wrench that had just come in that morning as the result of a trial order.

He explained the new anchor to the irate owner. Showed him how it screwed in without any digging or disturbance of his lawn.

The owner was pacified. The superintendent and men were pleased. Moral: "The Anchor to use is the one that screws."

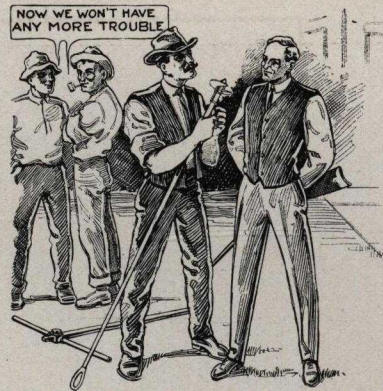


Figure 14

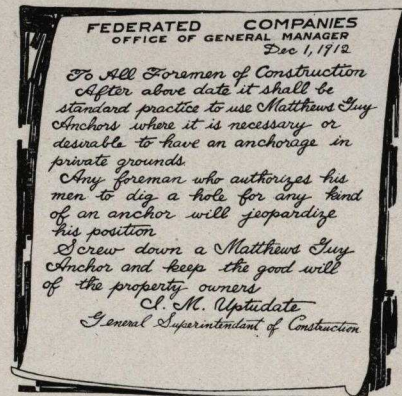


Figure 16



Figure 18



Figure 20

SHOWING HOW A RAILROAD COMPANY SAVED A LOT OF MONEY

BY USING

MATTHEWS GUY ANCHORS

The accompanying photographs show the way that the Louisville & Nashville R. R. Co. saved a lot of money and time by the purchase of a dozen 12-inch Matthews Guy Anchors.

This was in April, 1913, during the unprecedented rise of the Wabash and Ohio Rivers. They had a number of places where the track was floated off the roadbed by the floods.

The photographs were taken just after leaving Maunie, Ill., which is just about two miles from the normal banks of the Wabash River. Figures 18 and 19 show what the photographer saw as he walked toward the Wabash River from Maunie. Figure 20 shows a man with a 12-inch Matthews Guy Anchor on his shoulder, taking it out to be screwed down again. Figure 21 shows the gang pulling back the track onto the roadbed. *Anchors screwed down under water.*

What they did was to screw down one of these anchors every fifty feet under the water. They then hitched their blocks and tackle to two of these anchors and pulled the track back up against the current onto the roadbed, where it was staked down as shown in Figures 19 and 20. They then unscrewed the anchors and carried them on ahead, where they were used again. The use of these anchors increased the speed of pulling back the track from 700 feet to 1,500 feet per day and enabled them to do the work much sooner than they could have done it, on account of not having to wait for the waters to recede further. *These anchors are used by wrecking crews of many railroads for pulling wrecks, derailed cars, etc., out of the right-of-way. Each wrecking car is equipped with two 12-inch Galvanized Matthews Guy Anchors. They can be screwed down in a few minutes and a loaded freight car or locomotive can be pulled off the track with them. They are then unscrewed and put back on the car for future use.*

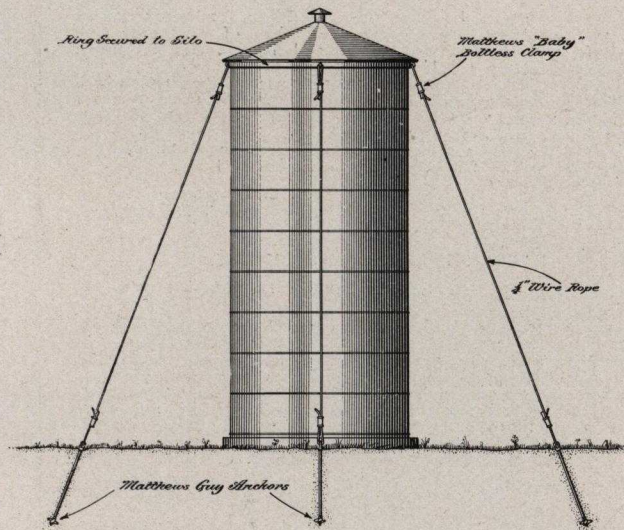


Figure 19



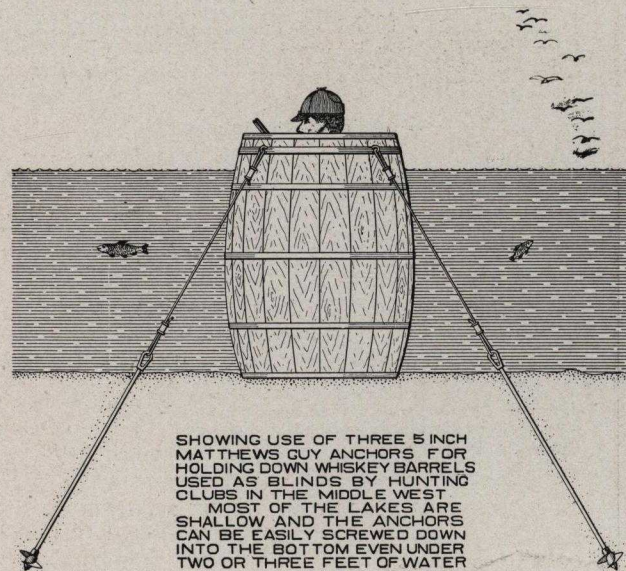
Figure 21

SOME DRAWINGS THAT HAVE BEEN SUGGESTED BY RECENT ORDERS



SHOWING USE OF FOUR SIX
INCH MATTHEWS GUY ANCHORS
FOR HOLDING SILOS IN THE
MIDDLE WEST

Figure 22



SHOWING USE OF THREE 5 INCH
MATTHEWS GUY ANCHORS FOR
HOLDING DOWN WHISKEY BARRELS
USED AS BLINDS BY HUNTING
CLUBS IN THE MIDDLE WEST
MOST OF THE LAKES ARE
SHALLOW AND THE ANCHORS
CAN BE EASILY SCREWED DOWN
INTO THE BOTTOM EVEN UNDER
TWO OR THREE FEET OF WATER

Figure 23

FOR FIFTEEN YEARS THE USERS OF MATTHEWS GUY ANCHORS HAVE BEEN SAYING:
"THE ANCHOR THAT SCREWS IS THE ONE TO USE"

Number 1

INDIANA TELEPHONE AND TELEGRAPH CO.

GENTLEMEN: CLINTON, IND., Feb. 25, 1914.

We have hundreds of your Matthews' Guy Anchors in use of the 5 and 6-inch sizes and I don't know of a case where one has pulled up. Some of them have been in use 8 years and still on the job. We consider it standard construction. We have some on private property which never could have been placed with a log.

J. L. HORNEY,
Manager.

Number 2

KINGSLEY TELEPHONE CO.

GENTLEMEN: KINGSLEY, IOWA, Feb. 27, 1914.

We have used the Matthews' Guy Anchor for some time. They save time and labor, also can be installed in town where it would be impossible to use others. They are neat and compact. We have never had any pull as yet on telephone work.

A. S. CREASY,
Manager.

Number 3

THE S. MORRISON TELEPHONE CO.

GENTLEMEN: GREENFIELD, IND., Feb. 24, 1914.

We bought about 75 of your Matthews' Guy Anchors some time ago, and have used most of these in the city on side guying and in places where we could not have secured permission to dig for a log, and will say that they are all giving best of satisfaction. Would surely advise anyone in need of any commercial anchor to buy the Matthews' Guy Anchor.

Wm. McCREA,
Manager.

Number 4

CHIPPEWA VALLEY RY., LIGHT & POWER CO.

GENTLEMEN: EAU CLAIRE, WIS., March 5, 1914.

Replying to your circular of February 25th in regard to the experience of this company with the Matthews' Guy Anchors, I wish to say this anchor has given excellent satisfaction in the small sizes for use in boulevards and where guy stubs would be objectionable.

Yours very truly,
J. J. KELLEY, JR.,
Supt. Lighting Dept.

Number 5

HOME TELEPHONE & TELEGRAPH O.

HENDERSON, N. C., Feb. 27, 1914

GENTLEMEN:

In answer to your letter of February 22nd, I take pleasure in stating that we have been using various sizes of Matthews' Guy Anchors for the past several years, and have found the same uniformly satisfactory in all grades of soil.

On a line which we built in the eastern part of the State, where the soil is extremely sandy, we were fearful that these Anchors would not stay put, but they seem to hold as firm as the Rock of Gibraltar in the wet season as well as dry.

We expect to use a great many of these during 1914.
With best wishes for your continued success, I am,

F. C. TOEPLERMAN,
Gen'l Manager.

Number 6

LARSEN TELEPHONE COMPANY.

LARSEN, WIS., Feb. 28, 1914.

GENTLEMEN:

In answer to your inquiry of February 27th, wanting to know the reason why we are using Matthews' Guy Anchors, in the first place we have some very heavily loaded poles, as many as twenty pairs of No. 12 wire, and where your anchors were used they always held where others would pull out or break. Our lineman says he does not know of a guy on our line that has budged an inch since we began using the Matthews' Guy Anchors, so we can recommend them to be O. K.

CHAS. C. CROSS,
Secretary.

Number 7

THE CLAY CENTER TELEPHONE COMPANY.

CLAY CENTER, KAN., Feb. 26, 1914.

GENTLEMEN:

Replying to your letter of February 23d, beg to say that for years we have bought and used nothing but the Matthews' Guy Anchors.

We find them very reliable and don't want anything better.

G. M. STRATTON,
Sec'y and Mgr.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

ASK THOSE THAT USE THEM WHETHER "THE ANCHOR TO USE IS THE ONE THAT SCREWS"

Number 8
DULUTH EDISON ELECTRIC CO.

GENTLEMEN:

DULUTH, MINN., March 6, 1914.
We have several hundred of your 6 and 7-inch Matthews' Guy Anchors in use and also several 10 and 12-inch Matthews' Guy Anchors which are giving perfect satisfaction under all conditions, and we have used them where the water was three feet over the ground and it would have not been possible to have used any other kind of an anchor under the same conditions. We have several other makes of anchors in use, but find that your anchors are the easiest and quickest to install under all kinds of conditions where ground is covered with water, in sand, gravel or clay.

R. B. JENNINGS, Superintendent.

Number 9
JASPER COUNTY TELEPHONE CO.

DEAR SIR:

RENSSELAER, IND., Feb. 25, 1914.

Replying to yours of the 23rd, will say that we still have our good opinion of your Matthews' Guy Anchors. We have probably 100 of them in use on all kinds of strains and have only words of praise for them. We have plenty of sand and quicksand soil, and I am sure you will agree with me that any anchor that will hold under these conditions will hold anywhere. I am for them.

J. J. MONTGOMERY, Superintendent.

Number 10
FORT DODGE, DES MOINES & SOUTHERN R. R. CO.

GENTLEMEN:

BOONE, IOWA, Nov. 1, 1913.

Referring to your letter of October 21st, in regard to my experience with Matthews' Guy Anchors, beg to advise that within the last eighteen months the Ft. Dodge, Des Moines & Southern Railroad Co. have, to my knowledge, used 1,600 6-inch Matthews' Anchors*, and have found them satisfactory under all conditions.

For an example of the life of the Matthews' Guy Anchor you can see any time you visit this road, 6-inch anchors that have been holding for seven years on 8-degree curves, a pole line carrying the following load: A three-phase No. 4 copper transmission line, two 500,000 C. M. feeders, three No. 9 copper wires, five No. 9 iron wires and a 000 trolley wire. At least one-half of these anchors lack two feet of being put down to the eye. The holding strength of this anchor is fully tested on this line by the continual beating of the span wires by the trolley poles flying off on the curves.

Very truly yours,

C. F. YOUNG, General Foreman.

*June 6, 1914.—Since above was written they have ordered 300 more.

Number 11
THE HOME TELEPHONE & ELECTRIC COMPANY.

GENTLEMEN:

BAIRD, TEX., Dec. 13, 1913.

Some time ago we bought fifteen of your Matthews' Guy Anchors—5-inch and 6-inch—for use on some rural lines. These were the first that I had ever seen and will confess that I was disappointed, for they did not look to me like they would hold any strain to speak of. However, as we had them we used them.

Now comes the funny part: We used them to hold poles with 8, 10, 12 and sometimes 14 No. 14 wires pulled as tight as the wire would stand. Of course they held when we installed them, but within the last two or three months our country has been wetter than I have ever known it before. In fact, so boggy along the roads, where the anchors were used, that it would take two mules to pull the front wheels of a wagon to town, and stock was bogging down in places. I expected to see a nice little tube of mud pulled out in each place where one of the Matthews' Guy Anchors was used, but on investigation not a one of them had given an inch.

We expect to use more as occasions demand.

B. RICHARDSON.

Number 12
UNITED TELEPHONE COMPANY.

GENTLEMEN:

MONROE, WIS., March 4, 1914.

In your letter of February 27th you ask why we use the Matthews' Guy Anchors. We believe that the strongest endorsement which we can give these is to simply say that we use them because we are thoroughly convinced that it pays us to do so, and we have not found anything as yet which in our estimation quite takes their place, consequently you may count upon our regular spring order as soon as we complete our estimate.

P. J. WEIRICH,
Pres. & Gen'l Mgr.

Number 13
SOUTHERN UTILITIES COMPANY.

GENTLEMEN:

JACKSONVILLE, FLA., Feb. 25, 1914.

Replying to your letter of February 23d asking for our opinion as to Matthews' Guy Anchors, I beg to advise that our reason for purchasing Matthews' Guy Anchors is that we think it is the best on the market.

Yours very truly,

A. C. BERGH,
Pur. Agt.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



ORDERS FROM SEVENTEEN FOREIGN COUNTRIES INDICATE THAT "THE WAY THEY SCREW DOWN GAVE THEM WORLD RENOWN"

Number 14

CITIZENS TELEPHONE COMPANY.

UPLAND, IND., Feb. 26, 1914.

GENTLEMEN:

We are pleased to advise you that we used Matthews' Guy Anchors exclusively in the construction of our lines and they have given universal satisfaction.

We have not had a single instance where an anchor pulled; but, on the other hand, we have had cases where the Guy Wire has broken without moving the anchor whatever, and we are convinced that "The Anchor that screws is the one to use."

O. S. SMITH.

Number 15

WATER, LIGHT AND POWER DEPARTMENT.

AUSTIN, TEX., March 4, 1914.

GENTLEMEN:

We have been using Matthews' Guy Anchors several years. We find that they are easily placed and give a good solid anchor, in addition to being neat in appearance. We are entirely satisfied with them, and are not looking for anything better.

Yours very truly,

W. L. EYRES,
Ass't Supt.

Number 16

INDIANAPOLIS LIGHT & HEAT COMPANY.

INDIANAPOLIS, IND., Feb. 24, 1914.

GENTLEMEN:

Replying to yours of the 23d inst., we have been using Matthews' Guy Anchors for several years, and are having very good success with them. They are easy to install and will hold anything.

Very truly,

T. A. WYNNE,
Vice-Pres.

Number 17

NEW YORK, PHILADELPHIA & NORFOLK R. R. CO.

CAPE CHARLES, VA., March 6, 1914.

GENTLEMEN:

Referring to your favor of the 25th ult., in regard to the Matthews' Guy Anchors, would advise that we have used a good many of these during the last two years, and find them entirely satisfactory.

Yours truly,

J. D. KING,
Div. Operator.

Number 18

MARYVILLE ELECTRIC LIGHT & POWER CO.

MARYVILLE, Mo., Feb. 23, 1914.

GENTLEMEN:

Would say we had used your Matthews' Guy Anchors for a good many years, but were induced to try some other makes about three years ago, but it did not take us long to get back to the Old Reliable.

We have never had any trouble with same, and the only ones we have ever known to pull out were where a street had been graded and nearly down to the bottom of the anchor. We are well pleased and expect to continue using same.

Yours truly,
C. C. HELLMERS,
Manager.

Number 19

NASHVILLE ELECTRIC LIGHT COMPANY.

NASHVILLE, ILL., Feb. 27, 1914.

GENTLEMEN:

Replying to your favor of the 23d inst. We have been using Matthews' Guy Anchors exclusively for the past five years and consider them great protection against sleet and wind storms.

We find that they will stand an extraordinary strain under all conditions of service and indispensable for modern line construction.

Very truly yours,
K. A. STEINHAUSER,
Manager.

Number 20

EFFINGHAM ELECTRIC LIGHT & POWER COMPANY.

EFFINGHAM, ILL., March 1, 1914.

GENTLEMEN:

We have been using Matthews' Guy Anchors for more than eight years, and with the exception of first lot which did not have the screw top, we have never had one to fail. We have tried a number of other types of anchors, but we have failed to find any so easily installed or that stay in like the Matthews' Guy Anchor. They beat the old "dead man" because they cost no more in the first place, cost less to install, require no disturbance of the ground where installed.

Yours truly,
W. G. AUSTIN, Manager.

Number 21

MUNICIPAL WATER AND LIGHT PLANT.

HORTON, KAN., Feb. 26, 1914.

GENTLEMEN:

We use Matthews' Guy Anchors because they are easily set, durable and reliable. During the past three years we have not had a Matthews' Guy Anchor pull up under any condition.

Yours truly,
W. W. WOOD,
Superintendent.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

THE SALE OF MORE THAN A MILLION MATTHEWS GUY ANCHORS SHOWS THAT "THE ANCHOR THAT SCREWS IS THE ONE TO USE"

Number 22

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE
RAILWAY COMPANY.

MINNEAPOLIS, MINN., Feb. 25, 1914.

GENTLEMEN:

I have been using your Matthews' Guy Anchors for the past two seasons in both construction and reconstruction work on our telegraph line, and find there is a great saving in labor and cost in using these guy anchors over the old method of digging holes to install the anchors in former use. I shall continue to use Matthews' Guy Anchors where it is necessary to install anchors on curves, especially on lines where general repairs are needed.

Yours truly,

E. B. DODD,
Signal Superv.

Number 23

DEPEW & LANCASTER LIGHT, POWER & CONDUIT
COMPANY.

LANCASTER, N. Y., March 2, 1914.

GENTLEMEN:

We use a large number of Matthews' Guy Anchors, and I wish to state that we have never had any trouble with these anchors when properly placed.

Yours truly,

A. R. TREMAINE,
Superintendent.

Number 24

PUBLIC SERVICE COMPANY OF OKLAHOMA.

TULSA, OKLA., March 1, 1914.

GENTLEMEN:

We commenced to use the Matthews' Guy Anchors about three years ago, and have continued to use them for the reason they are of no great expense to install, and the greatest reason is they will hold the load. We have Matthews' Guy Anchors holding lines where other anchors have pulled up.

Another reason for using Matthews' Guy Anchors is when you place one in the ground at a good depth we can put a strain on it and then come back to it in thirty days and it has given no slack in the line as so many other anchors will do before they will open out to hold their strain.

Yours truly,

P. G. WALKER,
Supt. El. Dept.

Number 25

THE HOME TELEPHONE COMPANY, Inc.

PAULDING, OHIO, Feb. 27, 1914.

GENTLEMEN:

We take pleasure in expressing our satisfaction with your Matthews' Guy Anchors. They are giving good service wherever we have used them.

WARD H. SNOOK,
Manager.

Number 26

CHARLES CITY LIGHTING & HEATING COMPANY.

CHARLES CITY, IOWA, March 30, 1914.

GENTLEMEN:

In reply to your inquiry as how we like Matthews' Guy Anchors, will say that we have used them for the past five or six years and have had no trouble with them.

We have given some of them rather unusual strains, as in some cases we have built a light line and anchored the dead end with an anchor designed for a light load, and later have put additional and heavier lines on these poles, and have not changed to a larger sized anchor, and still the anchors hold.

Our soil on one side of the river is sand, and on opposite side is clay, and the anchors seem to hold equally well in either soil.

We expect to continue to use the Matthews' Guy Anchor.

Yours very truly,

CHARLES CITY LTG. & Htg. Co.,
By H. L. DODD, Sec. & Mgr.

Number 27

CITY OF GRAND ISLAND.

GRAND ISLAND, NEB., Feb. 23, 1914.

GENTLEMEN:

In answer to your letter of recent date, I have been using your 5 and 6-inch Matthews' Guy Anchors at this place for the past thirteen years. I have quite a number of these anchors that have been in use here for that length of time and they are apparently as good as new.

I always use Matthews' Guy Anchors, because I think that they are the best.

Yours very truly,

J. H. MILLER,
Water and Light Commissioner.

Number 28

SUPERIOR WATER, LIGHT & POWER COMPANY.

SUPERIOR, WIS., March 2, 1914.

GENTLEMEN:

We beg to acknowledge receipt of your letter of February 25th relative to our experience with Matthews' Guy Anchors.

We have a large number of your anchors in service, which have proved very satisfactory. We have never had a case of anchor pulling out after being properly installed.

Respectfully yours,

P. C. MILLER, Supt. Elec. Dept.

Number 29

THE VAN WERT HOME TELEPHONE CO.

VAN WERT, OHIO, Feb. 28, 1914.

GENTLEMEN:

We have been using Matthews' Guy Anchors for some time and they have proven highly satisfactory.

They do the work for which they are intended and are quickly and easily installed.

J. W. LONGWELL, Secretary.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.





Figure 24



Figure 25



Figure 26



Figure 27



Figure 28



Figure 29

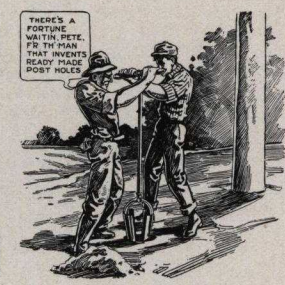


Figure 30

Some Horrible Examples

Which Simply Go to Show That The Anchor to Use Is the One That Screws



Figure 31



Figure 32



Figure 33

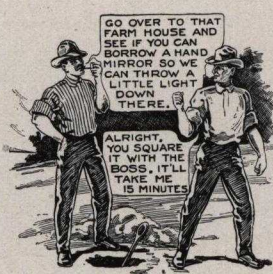


Figure 34



Figure 35



EXPLANATION

- P—Guyed pole in service.
- D—Deadman that is known to be satisfactory.
- A—Matthews' Anchor to be tested.
- B—Guy wire attached to "A."
- C—Guy wire attached to "D" before strain is placed on "A" and "B."
- C'—"C" after strain has been placed on "A" and "B," and removed from "C" and "D."

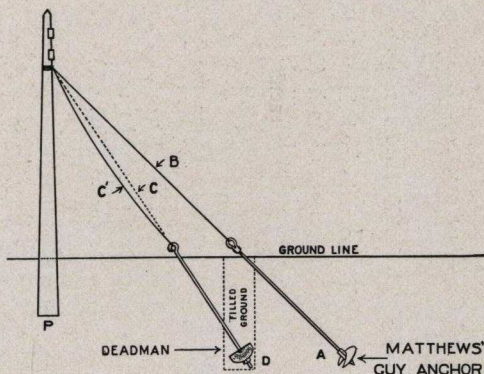


Figure 36.

AN EASY, ECONOMICAL, SAFE AND SURE TEST FOR FINDING THE VALUE OF A MATTHEWS' GUY ANCHOR

Referring to drawing above, "P" shows a pole in an existing loaded line that is anchored with a deadman "D," that is holding the strain satisfactorily. A Matthews' Guy Anchor is put down at "A," to which guys "B" are attached, and pulled tight enough to cause three or four inches of slack to come into the guys "C" attached to "D."

Now "A" is holding all of the strain formerly held securely by "D." Conclusion: If, after thirty days, the guys "C" are still slack, as shown by "C," then "A" is as satisfactory for holding this strain as "D." If "A" costs less, installed, than "D," there can be no question but that "A" is the better anchor, all points considered.

This kind of a test is fair, because it requires the anchor "A" to hold the same strain, at the same place and under the same conditions, as those that apply to "D," and shows first, whether "A" is sufficiently strong, and second, whether it is less expensive. Any other test is almost sure to be misleading.

There has been some tendency to regard the Matthews' Guy Anchor as a substitute for all deadmen. We make no such claims, but we do say, that if a little judgment is used in selecting the proper size, that they will hold most of the strains that come within the range of a pole-using company. The above test suggests a simple but accurate way of finding the value of these anchors for the conditions confronting each individual user of anchorages.

Four 502R Matthews' Guy Anchors installed as shown in Figures 2 and 4 on page 56 will cost 81 cents each in the ground, or \$3.24 every tenth pole. How much will it cost you to replace one pole in sleety weather?

THE ANCHOR TO USE IS THE ONE THAT SCREWS

DIRECTIONS FOR USING MATTHEWS GUY ANCHORS

(These directions are tied to every bundle of anchors shipped out of our factory.)

Matthews' Guy Anchors—5, 6 and 7 inch—can not be installed without a No. 567 Wrench. If you did not receive one with these anchors or if you do not possess one, telegraph for one immediately. If you have to install many Matthews' Guy Anchors close to fences, buildings, hedges or other obstructions, you should order a No. 765 Ratchet Handle for the No. 567 Wrench. This will make it easy to screw these anchors down in such places. A ratchet handle will be sent by the manufacturer via parcel post to anyone for \$3.50. A No. 1,332 Wrench, which includes the No. 567 Wrench and the No. 765 Ratchet can be had for \$5.00 each. (See page 9.)

No wrench is needed for screwing down the 8, 10 or 12 inch Matthews' Guy Anchors.

BEST WAY TO INSTALL MATTHEWS GUY ANCHORS

Anchors with Rods—5, 6 and 7 inch—Remove the eye of the anchor (Fig. 37), pass the rod through the wrench (Fig. 38), and see that the wrench is fitted tight to the square shank on the screw of the anchor where the rod goes into it (Fig. 39). Then replace the eye on the rod which you will find sticking out at the other end of the wrench. Screw the eye on so that it will fit tight (Fig. 40).

You are now ready to screw the anchor down and it looks like Fig. 41.

The next thing to do is to remove a spadeful of earth at the spot where you want to screw the anchor down. Now screw the anchor down until you can go no farther. It should be screwed down at least five feet. (See Fig. 42.)

This will leave about one foot of the rod sticking out of the ground. The anchor should be screwed down three or four degrees less than the guy wire is to run. Just a little bit straighter down than the guy wire runs. (Fig. 43.)

If the angle is such that the handles of the wrench strike the ground before the anchor has been screwed in its full depth, or when necessary to screw anchor down close to a fence, then take off handles and use the ratchet handle. This will make it possible to screw the anchor down to its full depth. While one man is working the ratchet, the other should be holding the tube of the wrench to the angle that it was started in until the ratchet began to be used. (See Figs. 44 and 45.)

"THE ANCHOR TO USE IS THE ONE THAT SCREWS"



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

DIRECTIONS FOR USING MATTHEWS GUY ANCHORS



Figure 37



Figure 38



Figure 39



Figure 40



Figure 41

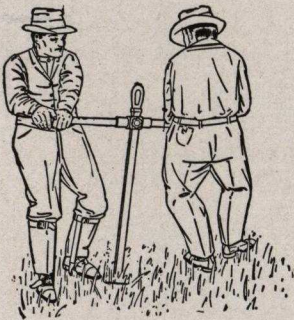


Figure 42

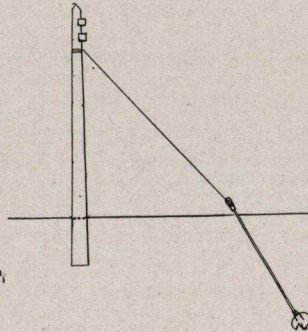


Figure 43

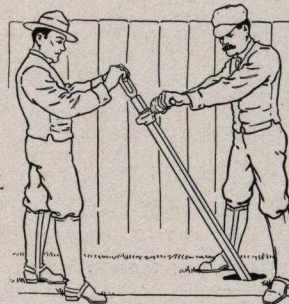


Figure 44

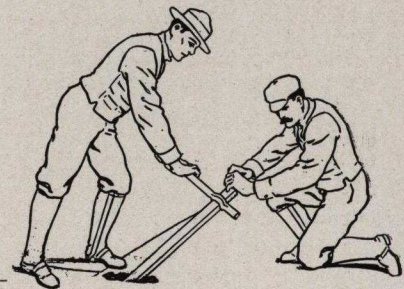


Figure 45

"THE ANCHOR TO USE IS THE ONE THAT SCREWS"

"THE ANCHOR TO USE IS THE ONE THAT SCREWS"

DIRECTIONS FOR USING MATTHEWS' GUY ANCHORS

When the anchor has been screwed down as far as possible remove the eye from the end of the rod and pull out the wrench. As blocks and tackle are almost always handy the wrench can be more quickly pulled out by attaching the blocks to the handles and pulling on them. As soon as the wrench is removed put back the spadeful of earth around the rod and stamp it down with your feet. Then screw on the eye as far as it will go. You are now ready to attach the guy wire. No digging. No filling. No tamping. No backache. Not nearly as hard as digging a hole. And yet these anchors are safe and you can trust your weight on the poles they are holding.

8, 10 AND 12 INCH ANCHORS WITH RODS.—These anchors are even easier to screw down than the smaller sizes, because no wrench is used with them. Their rods are sufficiently strong to stand the twisting strain. You simply slip a digging or crowbar through the eye and screw it down in the same way as instructed above for the smaller sizes. No ratchet handle is needed, because the digging bar can be slipped back and forth through the eye to clear obstructions.

SPECIAL INSTRUCTIONS FOR SCREWING DOWN IN DRY, HARD GROUND

In setting all Matthews' Guy Anchors in hard ground, the work will be much easier if the hole is made with a digging or crowbar or a wood auger with a long shank. This makes the path of the anchor easier. A little water poured down the hole before starting the anchor will help considerably where the ground is hard and dry. The use of the No. 765 Ratchet Handle will give an additional leverage to the regular handles.

In installing 8, 10 and 12 inch anchors in very hard ground, clamp a lever to the rod by means of a chain, a foot or so above the ground. As the anchor is screwed down the lever can be moved up. The anchor will start easier if a few spadefuls of earth are removed at the angle desired to set the guy. If a man stands on the helix of the anchor when starting, until the point bites the ground, it will assist.

The greater the depth that Matthews' Guy Anchors are installed, the greater the strain they will hold. These anchors will hold greater strain if the hole is scooped out so that the anchor can be bored in deeper. In localities where loose gravel or small, flat rocks occur, drill a hole with a digging or crowbar, as suggested above. If a small rock is encountered it can be broken by the bar. If a large rock is "discovered," the bar can be removed and the hole drilled in another place. This will permit the use of Matthews' Guy Anchors in many places where it would seem impossible to install them.

Matthews' Guy Anchors will save a very great amount of money for those who have to obtain safe ground anchorages in dry sand, quicksand or swampy ground. In fact, the only safe substitute is a very expensively constructed board or concrete anchorage which has to be put down by constructing a cofferdam or "barrel" to keep the sand or water out of the hole while it is being dug.

The Commonwealth Edison Co. and the Chicago Telephone Co., both of Chicago, have used thousands of 6-inch Matthews' Guy Anchors in and around Chicago, where practically all of the ground is underlaid with quicksand. (See letter No. 9, on page 65.)

Write us if you are unsuccessful in installing these anchors. Our experience generally enables us to suggest a way to overcome difficulties. Do not condemn them without giving us a chance to offer suggestions.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

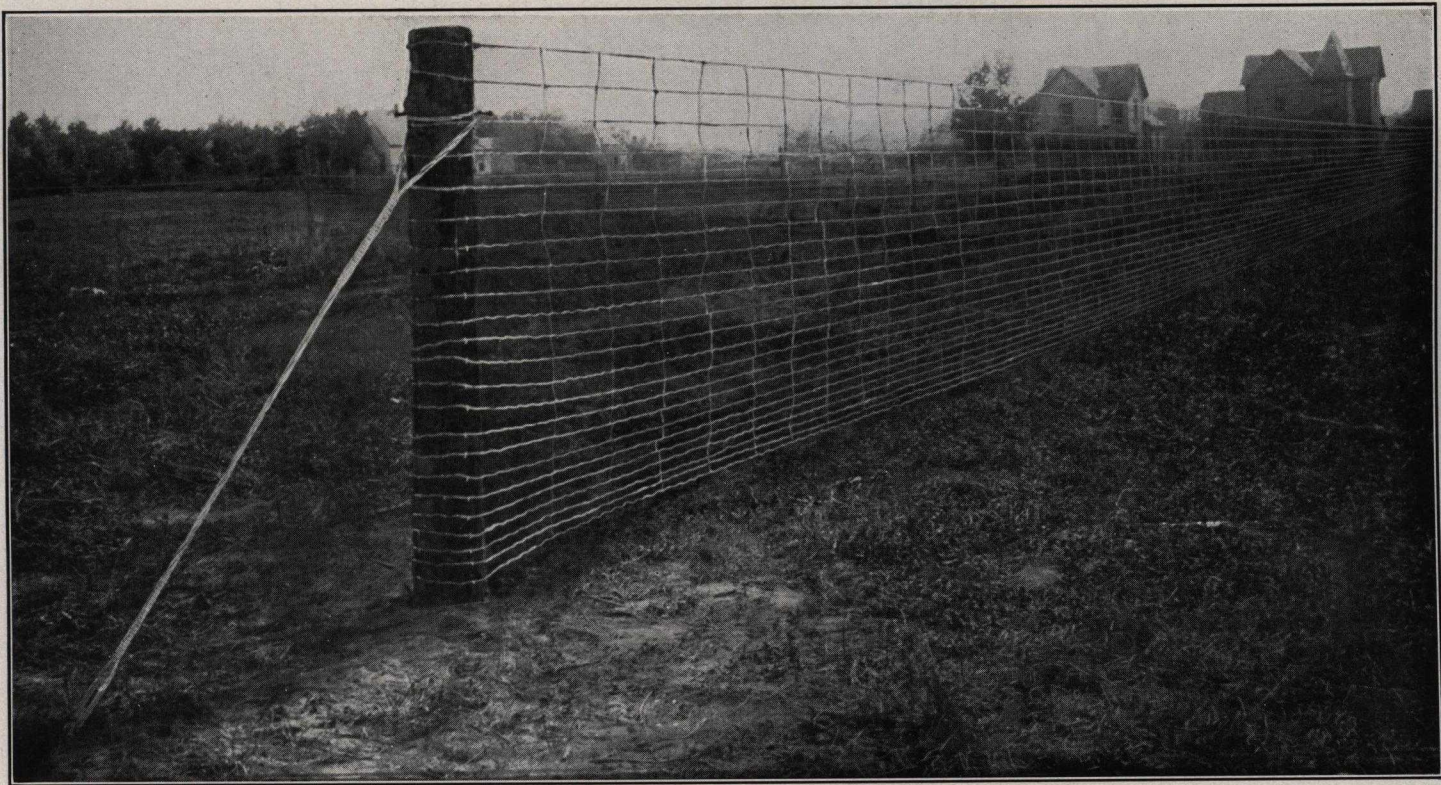
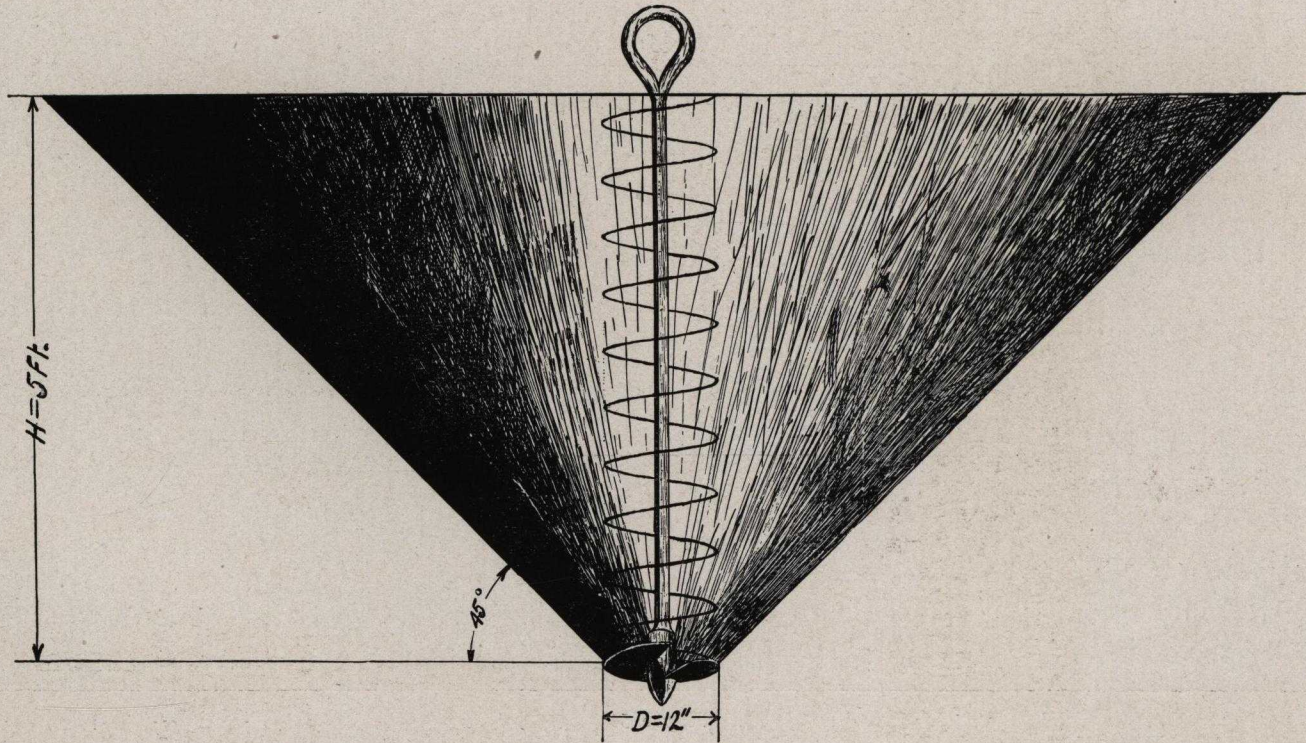


Figure 51

Six hundred feet of crimped wire fence near Anderson, Ind., anchored by one six-inch Matthews Guy Anchor. Put in by two men in nine and one-half minutes. Estimated strain six and one-half tons.

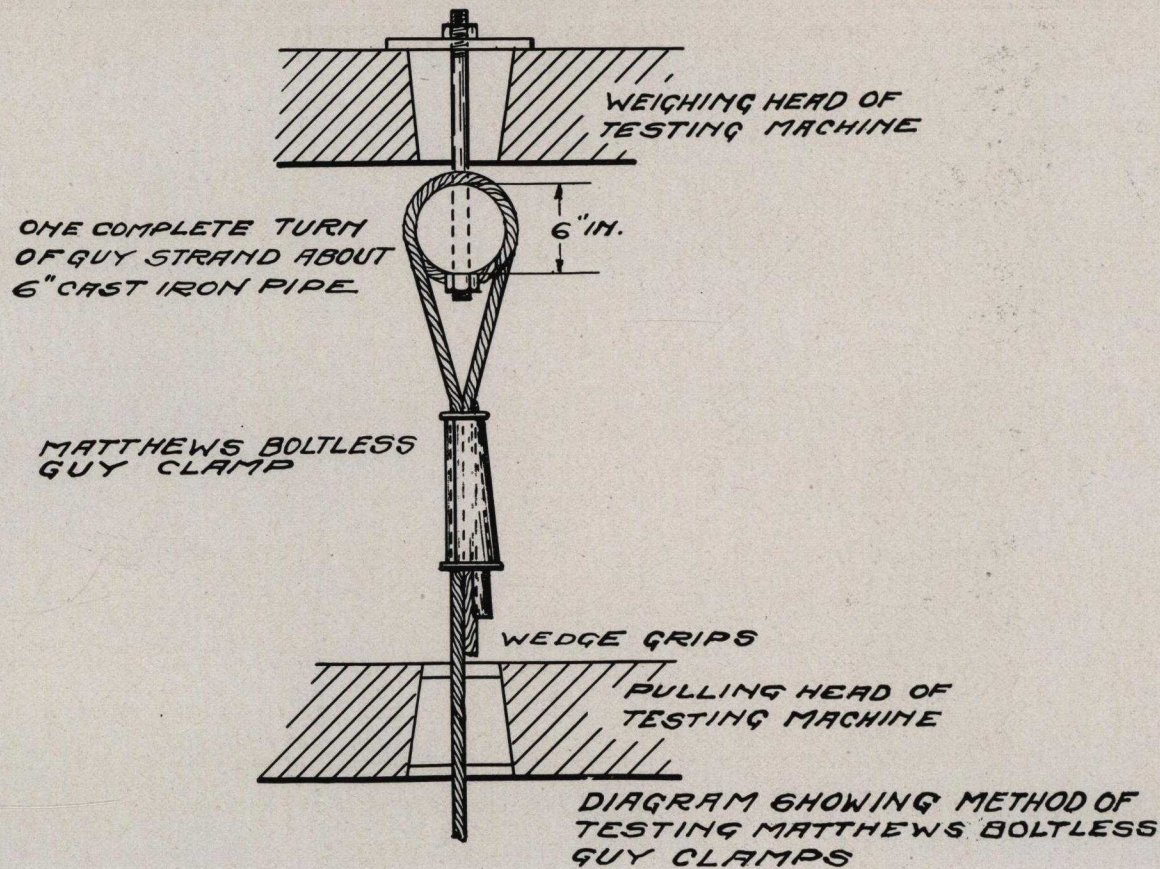
WHY MATTHEWS GUY ANCHORS HOLD SO MUCH



Shows lines of force that extend 45° on each side of the rod, and add a large part of the dead weight of the inverted cone of earth taken in by these lines.



Showing how The Electric Co. of Missouri use Matthews Giant Boltless Clamps on lines in St. Louis County, Mo.,
distributing Keokuk Power.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



HOW A SLOGAN WAS SUGGESTED

By Claude L. Matthews

It was in April, 1913, in the Laboratory of Applied Mechanics of the University of Illinois at Champaign, Ill. We were making some tests on the holding power of various guy clamps—Professor Moore, two senior engineering students and I. I was there in the interest of Matthews' Boltless Guy Clamps.

Some of the story will be omitted for the sake of brevity. The results of two typical tests will be given. By reference to the drawing on page 76 the method of testing will be seen. The machine was the well-known Riehle Testing Machine, capacity 50,000 pounds.

TEST No. 1

Matthews' Baby Boltless Guy Clamp. Strand used 5/16 inch Siemens-Martin. One wrap around 6 inch cast-iron pipe.

Load	Slip	Load	Slip
1,000 pounds	.0 inches	4,500 pounds	.229 inches
1,500 "	.005 "	5,000 "	.436 "
1,950 "	.010 "	5,500 "	.678 "
2,500 "	.018 "	6,000 "	1.125 "
3,000 "	.028 "	6,200 "	1.684 "
3,500 "	.040 "	6,500 "	2.000 "
4,000 "	.074 "	6,820 "	Broke

TEST No. 2

Matthews' Giant Boltless Guy Clamp. Strand used 3/8 inch Siemens-Martin. (This strand should have held 10,000 pounds or more, but of several samples tested it did not come up to guarantee.) One wrap around 6 inch cast-iron pipe.

Load	Slip	Load	Slip
1,000 pounds	.0 inches	5,000 pounds	.048 inches
1,500 "	.0 "	5,500 "	.048 "
2,000 "	.0 "	6,000 "	.053 "
2,500 "	.0 "	6,500 "	.063 "
3,000 "	.0 "	7,000 "	.077 "
3,500 "	.029 "	7,500 "	.110 "
4,000 "	.033 "	8,000 "	.236 "
4,500 "	.048 "	8,320 "	Broke

If a wooden pole had been used and if the loose end of the guy strand had been served to the through strand in accordance with the general practice, the slip would not have been noticeable.

It will be noted that in Test No. 1, there was only 74/1000 of an inch slip up to 4,500 pounds. Then the strand began to lessen in diameter and the slip became more pronounced as the strain was increased. The wedge followed into the sleeve as the strand decreased in diameter and took up the strain. From 5,500 pounds to 6,820 the slip was much more pronounced. This was because the lessening of the diameter was more rapid due to the elongation of the strand just before it broke. If the strain had been eased off anywhere below 6,800 pounds, the guy strand would not have broken and the clamp would have held the strain.

In all tests of the ordinary 3-bolt clamps, as soon as the strain reached 5,000 to 5,500 pounds, the strand started to slip through and continued to do so as long as the strain remained between these points.

In Test No. 2 it will be noted that the clamp held with practically no slip at all up to the breaking point of the strand—only 236/1000 of an inch.

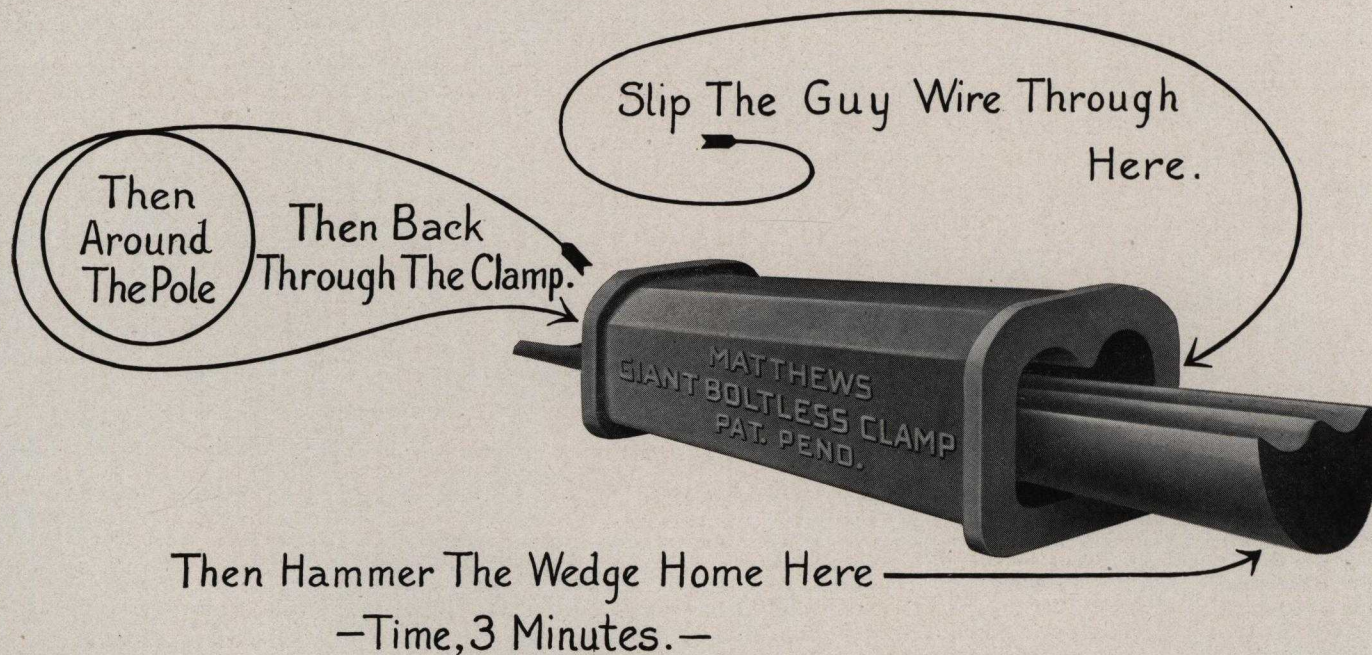
The fact that Matthews' Boltless Clamps do not permit the strand to continue to slip, but automatically compensate for the lessened diameter caused some one to say:

"THE WAY THEY WEDGE IS A SAFETY PLEDGE,"
And that has been our slogan for them ever since.

You can't expect to have a man at each 3-bolt clamp when severe wind storms put more than 5,000 pounds strain on them. If you don't they will slip. Matthews' Boltless Guy Clamps can be absolutely depended upon for 5,000 pounds (Baby) and 8,000 pounds (Giant).

If your strains are going to be greater than 8,000 pounds, use Matthews' 2-Bolt Guy Clamp. It is good for 16,000 pounds. See letter No. 13, page 81.

INSTRUCTIONS FOR INSTALLING MATTHEWS BOLTLESS GUY CLAMPS



To take slack out of the line before driving the wedge home, first give a light tap on the wedge, then on the sleeve, then on the wedge, etc., until the clamp reaches the desired position, then drive the wedge in as far as it will go.

That is all there is to it. Simplicity itself.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



ASK THOSE THAT USE MATTHEWS' BOLTLESS GUY CLAMPS

Number 1

HASKELL TELEPHONE COMPANY,

HASKELL, TEX., Jan. 10, 1914.

GENTLEMEN:

Thought I would just reply to yours of December 15th and tell you that we have "got the habit" of using Matthews' Boltless Guy Clamps and Anchors, and like them very much. Will continue to use them as long as they give such service as they are now doing.

A. J. COMBS, SR.,
Gen. Manager.

Number 2

THE S. MORRISON TELEPHONE CO.

GREENFIELD, IND., April 10, 1914.

GENTLEMEN:

We have used quite a number of your Matthews' Boltless Clamps and they give us entire satisfaction. Are much more handy to use than the ones using bolts, and a smaller size can be used for the same strain that a bolt clamp would necessitate.

Yours very truly,
WM. McCREA,
Sec'y and Treas.

Number 3

FRAZEE TELEPHONE CO.

FRAZEE, MINN., April 10, 1914.

GENTLEMEN:

In reply to yours of 7th, will say that we have used a few of your Matthews' Boltless Guy Clamps and like them so well that intend to use them entirely in the future. Have also used some of your anchors and have found that on light work one man with the use of the ratchet handle and a piece of gas pipe can install a 5 or 6-inch anchor alone in ordinary soil in from fifteen to twenty minutes. This makes it handy for small jobs in the country.

Yours,
L. L. SWAIN,
Manager.

Number 4

FRUITVILLE TELEPHONE CO.

VILLA RIDGE, ILL., April 14, 1914.

DEAR SIR:

In reply to your inquiry will say the Matthews' Boltless Guy Clamps are the best we have ever used. They certainly give entire satisfaction; they hold where you put them. Our linemen say they sure are the clamps for their use. Whenever we need more, we will surely order the Matthews' Boltless Guy Clamps. You have our permission to use this letter if you wish.

Very truly yours,
H. G. HOGENDOBLER,
Sec'y and Treas.

Number 5

RALEIGH TELEPHONE CO.

RALEIGH, N. C., April 11, 1914.

GENTLEMEN:

We believe your Matthews' Boltless Guy Clamps are superior to any other.

Yours truly,
W. A. WYNNE,
President.

Number 6

PUGET SOUND INDEPENDENT TEL. CO.

EVERETT, WASH., April 14, 1914.

GENTLEMEN:

Relative to the service ability of your Matthews' Boltless Guy Clamps, will say that we think very highly of them. They are easily put on and, as far as I know, there is no chance for them to give way.

Very truly yours,
L. J. THALLER,
Superintendent.

Number 7

DIXON HOME TELEPHONE COMPANY.

DIXON, ILL., April 28, 1914.

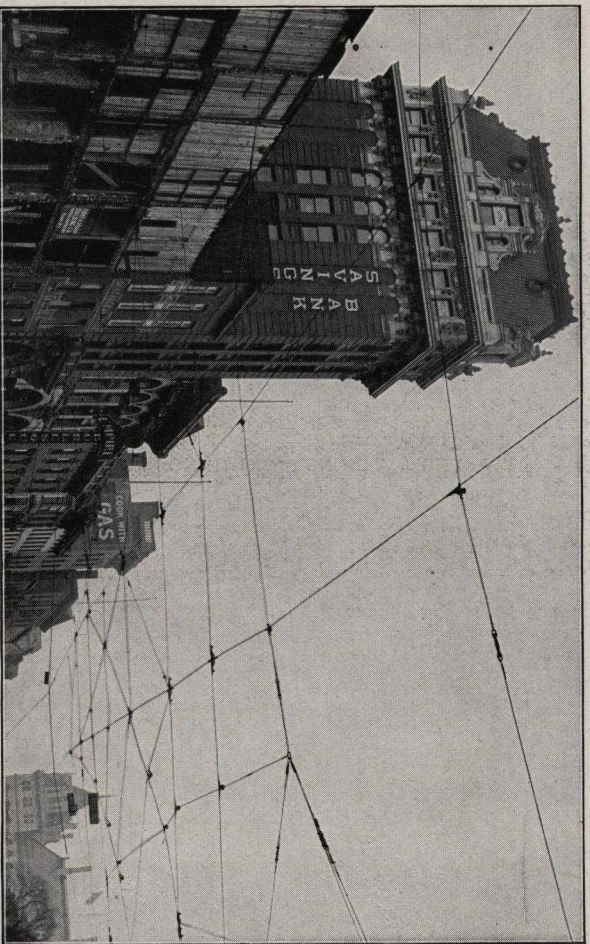
GENTLEMEN:

In reply to your letter of April 7th, wish to say that we are very well satisfied with the Matthews' Boltless Guy Clamps; they are easily and quickly installed, and seem to be a very secure fastening for the wire.

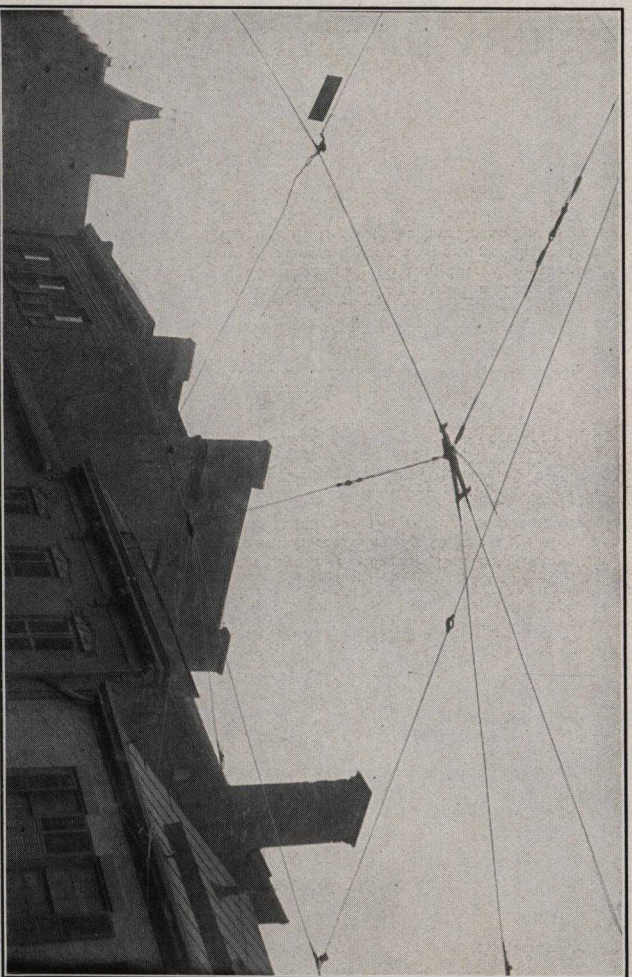
Very truly yours,
DIXON HOME TELEPHONE CO.,
Louis Pitcher, Manager.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.





Showing neat and unobstrusive appearance of Matthews Boltless Clamps
as used by the United Traction Co., Albany, N. Y.



Closer view of Albany Trolley Construction using Matthews Boltless Clamps.

A "CINCH" TO APPLY TO ANY GUY

Number 11

UNITED TRACTION CO.

ALBANY, N. Y., Dec. 18, 1913.

GENTLEMEN:

In reply to your letter of December 13th, regarding Matthews' Boltless Guy Clamps, would say that I have been using boltless guy clamps and find them to be a great saving, especially in guys for frogs and crossings where renewals have to be made.

Yours very truly,

HARRY J. CHILDS,

Engineer of Power and Lines.

Number 12

UNITED TRACTION CO.

ALBANY, N. Y., April 10, 1914.

Dear Sirs:

Yours of April 7th, addressed to the United Traction Company, regarding Matthews' Boltless Guy Clamps, has been referred to me. If you will refer to my letter of December 18, 1913, you will find my opinion of these boltless guy clamps, in which I expressed my entire satisfaction, and continued use of these proves that I find them economical and their holding power satisfactory and that I expect to use more of them. I am,

Very truly yours,

HARRY J. CHILDS,

Engineer of Power and Lines.

Number 13

THE NORTHERN OHIO TRACTION & LIGHT CO.

AKRON, OHIO, April 16, 1914.

GENTLEMEN:

In regard to your letter of the 8th inst., on inquiry of Matthews' Boltless Guy Clamps, will say that I have used quite a number of them and will continue to use them as occasion demands. I have put dynamometer tests on the same and find that the comparison of their holding power with that of other companies is very good. Trusting that this information is satisfactory, I remain,

Yours very truly,

W. E. SALBER,

Supt. of Lines.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

Number 7

SOUTHWESTERN TRACTION CO.

TEMPLE, TEX., April 11, 1914.

GENTLEMEN:

Replying to yours of April 8th, beg to advise that we are small purchasers of your Matthews' Boltless Clamps, and where we have used them we have found them both economical as to material and labor. Their holding power is satisfactory. When we have occasion to order some more material of this character you will probably hear from us.

Yours very truly,

SOUTHWESTERN TRAC. CO.,

W. G. HAAC, Supt.

Number 8

THE SOUTHWEST MISSOURI RAILROAD CO.

WEBB CITY, MO., April 15, 1914.

GENTLEMEN:

In reply to yours of the 7th inst., we used the Matthews' Boltless Guy Clamps that were shipped on a trial order and proved to be satisfactory. We are not in the market for anything in line material.

Yours truly,

E. J. PRATT,

Number 9

MILFORD & UXBRIDGE ST. RY. CO.

MILFORD, MASS., April 11, 1914.

GENTLEMEN:

In reply to yours of the 7th inst., would say that we liked the Matthews' Boltless Guy Clamps very much. They are easy to put on, and stay in place well.

Yours truly,

W. L. ADAMS,

Superintendent.

Number 10

THE DUTCHESS LIGHT, HEAT AND POWER COMPANY.

OF RHINEBECK, N. Y.

RHINEBECK, N. Y., April 21, 1914.

GENTLEMEN:

We are using the Matthews' Boltless Guy Clamps in our new construction work and are very much pleased with same.

Very respectfully,

R. RAYMOND RIKERT,

Manager.

ASK THOSE THAT USE MATTHEWS BOLTLSS GUY CLAMPS

Number 17
WATER & LIGHT COMMISSION OF THE CITY OF FAIRMONT.

Fairmont, Minn., April 11, 1914.

GENTLEMEN:
Your letter of the 7th at hand regarding Matthews' Boltless Guy Clamps. We are well pleased with same and expect to use more of them this season. In fact, all of the specialties that you manufacture are of a high class, and I have nothing but the highest commendation for all of your materials that we have used.

Yours truly,
ALFRED HORNE,
Superintendent.

Number 18
MUNICIPAL ELECTRIC LIGHT PLANT.

City of Columbus, Ohio, April 10, 1914.

GENTLEMEN:
In reply to your letter of April 8th, wish to say that we have used your Matthews' Boltless Guy Clamps for about four years, and we are pleased to take this occasion of saying we have found them highly satisfactory.

Yours very truly,
H. E. EICHENORN,
Superintendent.

Number 19
CONWAY ELECTRIC LIGHT & POWER CO.

Conway, N. H., April 16, 1914.

GENTLEMEN:
In reply to yours of April 7th, and wish to say that we are using your Matthews' Boltless Guy Clamps, and find them perfectly satisfactory in every way. You may use our testimonial in any way in which it will be of value to you. We have a sufficient number of clamps on hand for the completion of our work.

Yours respectfully,
CONWAY Elec. Light & Power Co.,
Per B.

Number 20
RUPERT ELECTRIC CO.

Rupert, Idaho, April 13, 1914.

GENTLEMEN:
Yours of the 7th. We are using Matthews' Boltless Clamps, and when we need more clamps we will order more boltless, as they seem to fill the bill all right, not only in doing their work but in pleasing the men who use them, which is equally important.

Yours truly,
F. N. VICTOR.

THE MIDDLETOWN GAS AND ELECTRIC COMPANY.

Middletown, Ohio, April 23, 1914.

GENTLEMEN:
In answer to yours of April 8th, with regard to your Boltless Guy Clamps also Guy Anchors, please be advised that we have used a few of these to date and find them the very best we have ever used, and have purchased more from dealers in Dayton.

Respectfully yours,
F. E. SCHIRZINGER.

Number 15
THE HELENA LIGHT & RAILWAY CO.

Helena, Mont., April 14, 1914.

GENTLEMEN:
The case of installation, the holding power, and first cost, are the three things which recommend the Matthews' Boltless Clamp. We are using them on all our guy work and know that they will do all that your company claims for them.

Yours very truly,
C. C. BERNIER,
Supt. Elec. Dept.

Number 16
CITY OF EAST GRAND FORKS.

East Grand Forks, Minn., April 20, 1914.

GENTLEMEN:
Replying to your recent letter of inquiry regarding our experience with Matthews' Boltless Guy Clamps, would say that of approximately 400 which we used last season we had two cases where the clamp slipped on the guy when strain of taking slack out of the line was applied. Careful investigation failed to reveal the cause of this action, and as it represented only one-half per cent of all of the work, our opinion is that the clamps had become loose after being put on the guys or that they had not been driven entirely home, and our faith in the boltless clamps remains unshaken, and we will use nearly as many this summer as we did last, as we have found them to be such a material saving in time, and besides they make a neater job.

Very truly yours,

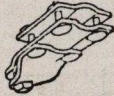
CHAS. E. FIEBS,
Supt. City Light & Power Dept.

W. N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U. S. A.



HEAVY WIRE TERMINATIONS*

By Anthony Gorham



Taken by permission from the Electrical World.

Broadly considered, the material and labor involved in the installation of a large open-work conductor may be divided into two general items, that necessary for supporting the conductor between termination points or "dead-ends," and that necessary for terminating or "dead-ending" the conductor. The installation of runs between termination points, as a rule, presents no difficulties. Insulating supports, which can be readily and ruggedly mounted, are commercially obtainable in many convenient types. These, spaced frequently, serve to support the conductor against lateral displacement, and to insulate it from adjacent materials.

Almost invariably the work of terminating a large open-work conductor is the most exacting, and frequently the most expensive unless expedient methods are used, involved in its installation. It should be added that the word "termination" as used here does not necessarily imply the actual termination of the conductor. Where the direction of a feeder run is changed (as shown, in Fig. 6, page 86), it is necessary that the conductor be "dead-ended," at the end of each run, to a strain-sustaining appliance. The same construction is involved at a "dead-ending" whether the run is actually terminated or whether its direction is changed, so the word "termination" as used in this article may imply either condition.

In modern industrial-plant practice it has been found best to depend entirely on the terminal supports for sustaining the longitudinal tension in the conductor and to incorporate with such supports appliances for tightening it, for mechanically connecting it with the tightening device and for insulating it therefrom. Obviously a vital requirement of any method of termination is that it shall be capable of sustaining a tensile stress great enough to keep the conductor it holds taut. Because of this requirement the only practicable methods involve the use of strain insulators of one type or other, which serve to transmit the tension in the conductor to some stationary support and at the same time to insulate the conductor from that support. For tightening, some form of bolt or turnbuckle is used.

From the standpoint of good construction, there appear to be but three feasible methods of making a heavy wire fast at its termination: (1) By carrying the wire (as shown in Fig. 2) without cutting it, through the eye of a strain insulator and serving the bight around the main line. (2) By cutting the wire carrying the end through the strain insulator eye and then serving this free end around the main line as shown in Fig. 3. (3) By using a cable clamp and a strain insulator as shown in all of the other drawings.

*See pages 12 and 13.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



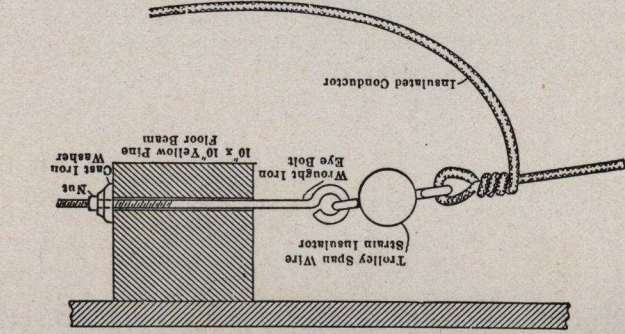


Figure 2. An uneconomical method of termination.

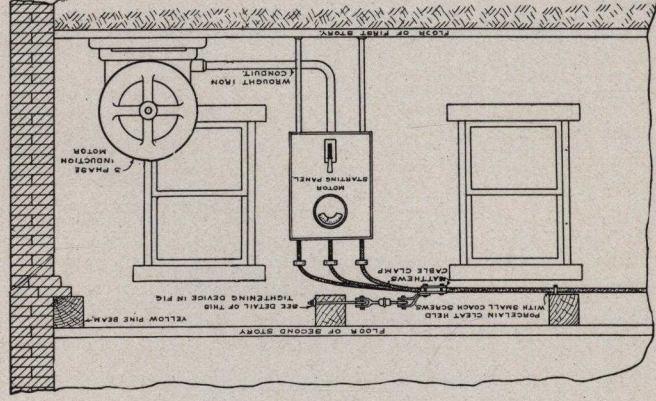


Figure 4. Terminating motor feeders.

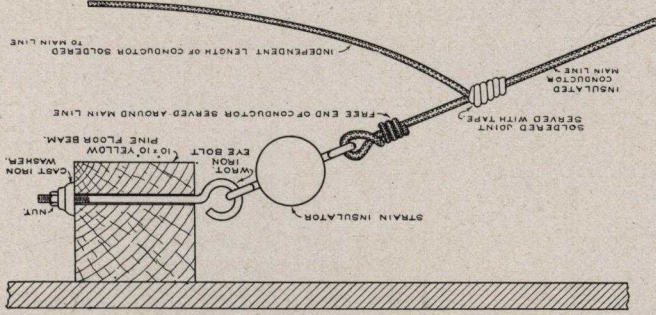


Figure 3. Another uneconomical method.

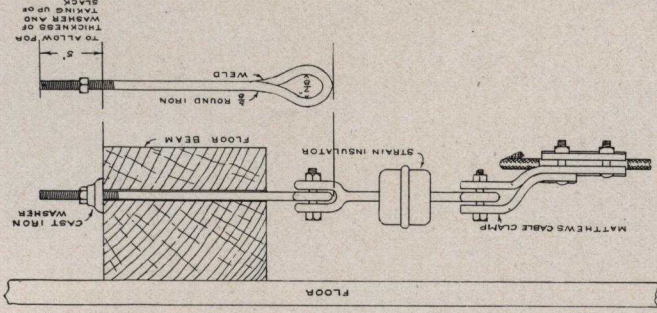


Figure 5. Detail of eye bolt in Figure 4.

Obviously, the first method (Fig. 2), can be advantageously applied only in the case of comparatively small conductors. With the exercise of much muscle, judgment and good workmanship, it is possible that it might be utilized in emergency cases where conductors as large as, say, 300,000 circ. mills. and even a little larger, are involved. The process, however, of bending the bight of the conductor of large size into a spiral-shaped serving around the main line is a time-consuming, and, therefore, an expensive one. This is particularly true where two adjacent terminations are necessary (as shown in Fig. 6) in the same conductor, because of a change in direction, or if the termination has to be made high above the ground from a staging or in a confined space. To sum up the status of this method it may be said that it is impossible to use it for very heavy wires and it is not to be recommended, because of the labor cost involved, for any except small wires, say, those smaller than No. 0.

In the method shown in Fig. 3 there is no limit to the size of the conductor that can be handled, inasmuch as a length, at the end of the conductor, can be "skinned" and the strands composing it unwrapped. Each strand can be carried through the strain insulator eye, one at a time, and served around the skinned portion of the main line. The served ends should then be soldered to the main line, to hold them in position and to prevent the joint failing upon the application of a tensile stress. Then an independent length of conductor must be served around and soldered to the main line as indicated. This independent length may convey electricity to the adjacent conductor (if the termination is made to permit of a change in direction of the run) or to a near-by energy consuming device. Here again the expensive item, labor, is an important factor. Unstranding the conductor ends, serving them around the main line and soldering them is slow, expensive work and if neatly done requires considerable skill. Furthermore, it is almost always necessary to cut off waste ends, which are usually too short to have any other than a junk value. It appears, then, that while this method is feasible for all sizes of conductors, it is expensive and should not be used if a less costly method is available.

In the other method (shown in all illustrations except Figs. 2 and 3) it is only necessary to bolt a cable clamp to the conductor, a section $4\frac{1}{2}$ inches long having been skinned for its reception, and to fasten the clevis of the cable clamp to the eye of a strain insulator. These operations require no skill and take but little time. The result is a neat, quickly completed, sturdy job. The conclusion is, therefore, that this method is the neatest and the most economical of all, if the cost of a cable clamp is less than the cost of extra labor and waste ends inherent to both the other methods. It will be found that in practically all cases the cost of the cable clamp will be less.

Absolute comparisons in dollars and cents have purposely been avoided in the above discussion of the relative merits of the three methods. This is because that, even if several examples were tabulated, definite labor rates, a specific number of men required to do the work and a certain cost of conductor would have to be taken, while they would be accurate for one plant in one section of the country, they would not apply absolutely to another plant in another section with a different grade of labor. Such variances might cause misunderstandings. It is believed that the truth of the conclusion that the clamp method is best and cheapest will, after what has been outlined, be conceded by all who have handled much heavy wire. If one doubts, he should terminate one end of a certain run by either of the first two methods and use the clamp method at the other, keeping costs in each case.

Descriptions of some examples of terminations representative of good practice follow. In each, because of its general superiority, the method in which a cable clamp is used to hold the conductor is utilized.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



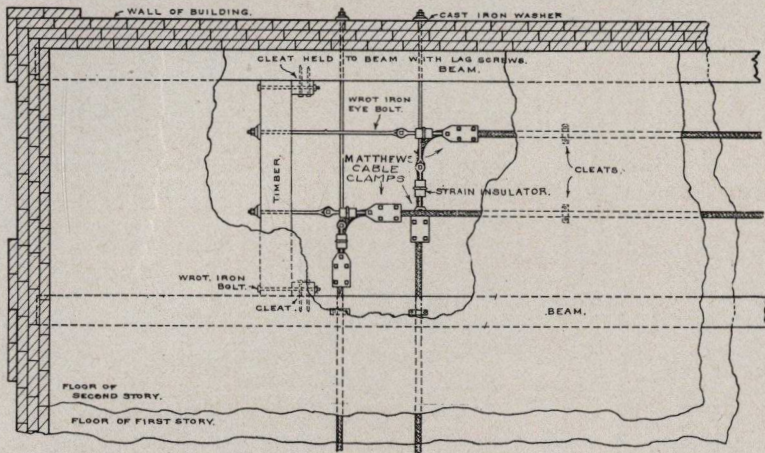


Figure 6. Right angle turn in heavy wires.

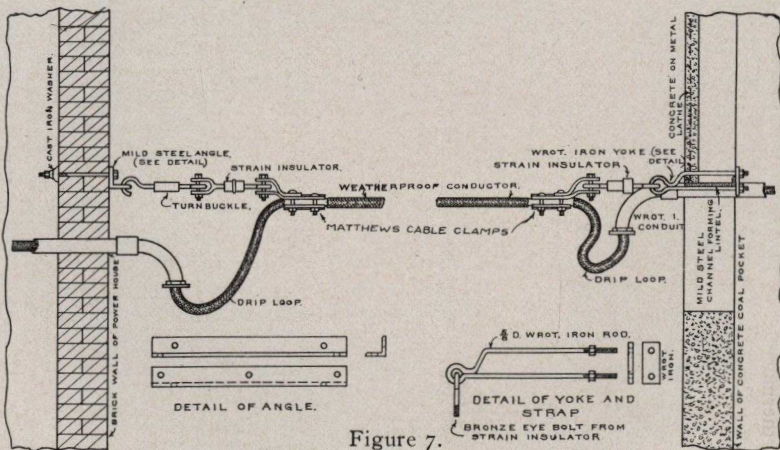


Figure 7.
Two terminations on same feeder.

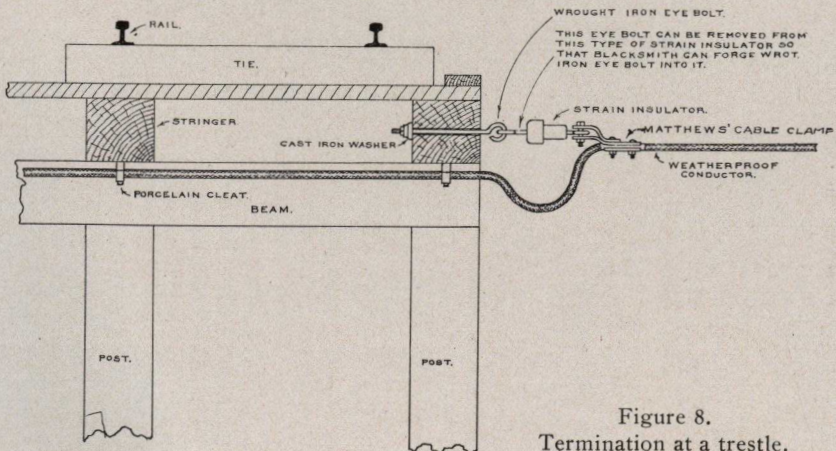


Figure 8.
Termination at a trestle.

Fig. 4 illustrates an excellent method of terminating wires conveying electricity to a large motor or other electrical appliance installed in a building of brick and wood "mill" construction. Enlarged details of the terminating appliances used in Fig. 4 are shown in Fig. 5. The cable clamp is held on the conductor by four $\frac{1}{2}$ -inch carriage bolts. A short section of the conductor is bared for its reception. The clamp provides a means of attaching the balance of the "dead-ending" equipment. The cable clamp is a patented contrivance and may be secured through any dealer in electrical supplies. The strain insulator shown, provided with an eye at one end and a clevis at the other, is also a commercial article. Its function is to transmit the pull in the conductor to the adjacent eye bolt, at the same time insulating one from the other. The eye bolt can be readily formed from $\frac{5}{8}$ -inch round wrought iron by any blacksmith.

Referring again to Fig. 4, it is assumed that at the other end of each of the wires therein shown that there is a terminal arrangement the same as shown in that figure. In erecting the job (Fig. 4) the conductors should first be strung through or raised up into the porcelain cleats which should be sufficiently loose about the conductor so as not to grip it. The conductor being in place in the cleats, a cable clamp is bolted to it at one end (which will be denominated end No. 1), a strain insulator bolted into this clamp, the eye bolt inserted in the hole through the beam and the washer and nut run on the eye bolt. The nut should be on only far enough to insure all of its threads engaging with bolt threads. End No. 1 having thus been temporarily made fast, the wire should be drawn taut from the other end, which will be designated as end No. 2. Accordingly another clamp is bolted, at the correct location, on the conductor at end No. 2. A sling from a set of tackle blocks is made fast around the conductor just forward of the clamp, which prevents the sling from slipping. The line from the tackle blocks is pulled upon and the greater part of the slack drawn from the conductor. If the point of application of the clamp at this end, No. 2, was well chosen, it should now be possible to engage the eye of the strain insulator (it having already been bolted to the eye bolt which, with nut and washer on, rests ready in the hole in the beam) with the clevis of the cable clamp and to insert the bolt that holds them together. This having been done, the conductor can be stretched as tightly as need be by turning the nuts on the eye bolts at ends Nos. 1 and 2. The job is completed by tightening the lag screws holding the porcelain cleats. The cable clamp and the "alive" metal portion of the strain insulator should be, in this and in all cases, served with insulating tape to meet National Electric Code requirements.

In Fig. 6 a plan view of a second-story corner of a mill building, with a section of the floor broken away, is shown. It indicates a substantial arrangement for making a right-angle turn in a two-wire feeder carried on a ceiling and on the lower face of the floorbeams. Cable clamps, strain insulators and eye bolts are used in much the same manner as described in connection with Fig. 4, and the description given in connection with that illustration applies here. Four terminating appliances are necessarily used in this case because strains in two directions must be provided for. It is profitable to consider the complication and labor that this job would have involved had the terminations been made without using cable clamps.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



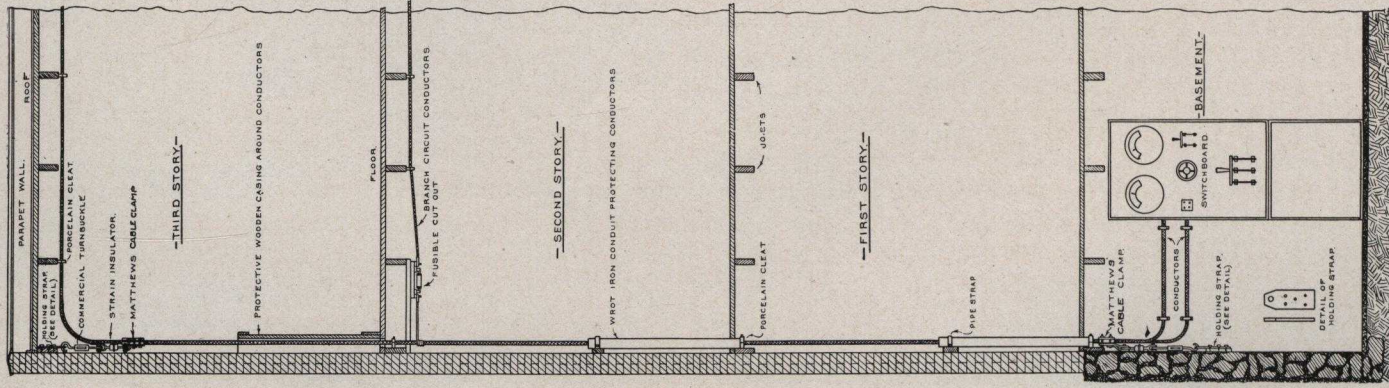


Figure 11. Four-story vertical run.

THIS MARK IN TRADE



MEANS HIGHEST GRADE

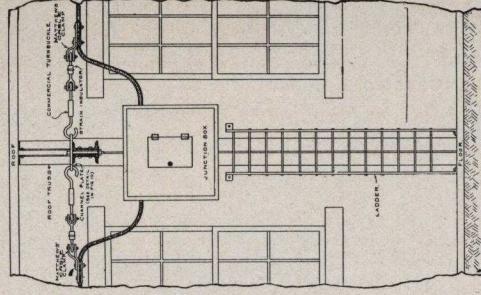


Figure 9. Dead-ends at a junction box.

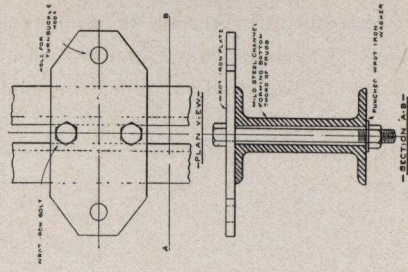


Figure 10. Detail of channel plate.

It is frequently necessary to install a heavy vertical feeder or "riser," several stories in length, to distribute energy for motors or lighting appliances installed on several stories of a structure. In Fig. 11 an excellent example of an installation of this character is delineated. Turnbuckles are availed of to tighten the conductor. These are threaded right-hand at one end and left-hand at the other, and may be purchased through any hardware concern. They are regularly manufactured in a variety of wrought-iron rod sizes and can be furnished with either eye-bolt or hook-bolt at either or both ends. The holding strap, detailed in the lower left-hand corner of the illustration, is cut from the wrought-iron or mild steel plate and the holes are drilled or punched through it. It is essential that this holding strap be substantially secured to its support. In the illustration it is shown held with lag screws to a wooden cleat, but in a steel-framed building it would be bolted to some steel member.

Fig. 8 illustrates a dead-end at a wooden trestle, such as frequently must be made in a feeder to an electric locomotive trolley wire or third rail. The only unusual feature of this application is the strain insulator which has an eye at each end instead of an eye at one end and a clevis at the other, as those previously referred to have had. One of these eyes can be removed, by unscrewing, to enable a blacksmith to forge and weld the eye of a wrought-iron eye-bolt into it. This procedure is impracticable with the ordinary type of strain insulator, because of the low melting point and inflammability of the insulating material used in strain-insulator construction. This type of insulator is designed to withstand the severest strains and is of considerably more rugged construction than the ordinary. All of its metal parts, with the exception of the insulated bolt, are of bronze.

The two out-of-door terminations shown in Fig. 7 are at opposite ends of the same run. The conductor shown carries electricity from a brick generating station to a coal-handling crane in a reinforced concrete coal pocket. It being a three-phase installation, three wires are necessary. A mild-steel angle, which is detailed in Fig. 7, bolted to the brick wall of the power house, provides means for attachment at that end and a special type of U-bolt or yoke, also shown in detail, made by the plant blacksmith, furnishes means at the other. It is to be noted that the eye in the U-bolt is forged around the removable eye of the strain insulator, which is of the heavy type referred to in connection with Fig. 8. This particular run is of No. 000 stranded wire and is 195 feet from building to building. There are no intermediate supports, the stress being wholly taken by the terminal cable clamp, strain insulators and bolts.

Mains feeding into a sheet-steel junction box are shown in Fig. 9. The junction box is attached to a steel column just under the bottom chord of the roof truss. Each of the conductors is supported, in its run down the building, on large porcelain cleats carried on the top of the channels constituting the roof truss bottom chords. The scheme used to provide attachment for the turnbuckle hooks is shown in detail in Fig. 10.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



MATTHEWS CABLE CLAMP

A FEW MONEY-SAVING SUGGESTIONS

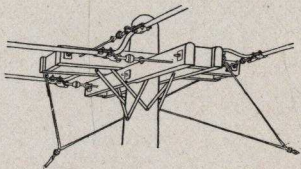


Fig. 12. An inside corner turn with Matthews Cable Clamps, using "bridle guys."

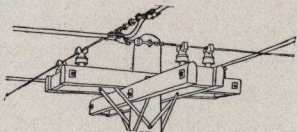


Fig. 13. Same as Fig. 12, using straight guys.

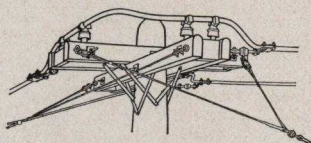


Fig. 14. Outside corner turn, using Matthews Cable Clamps and the "bridle guys."

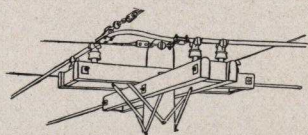


Fig. 15. The same as Fig. 14, using straight guys.

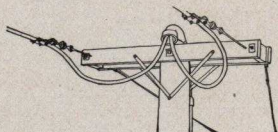


Fig. 16. Deadending two cables at U. G. junction pole by means of two Matthews Cable Clamps.

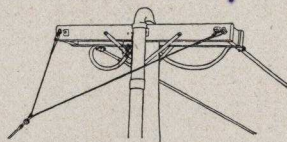


Fig. 17. Same as Fig. 16, showing back view.

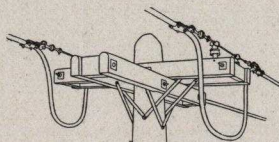


Fig. 18. Showing method of leaving slack in line for future use by means of using Matthews Cable Clamps.

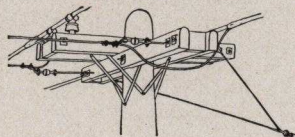


Fig. 19. Showing method of relieving the strain caused by right angle taps by means of Matthews Cable Clamps.

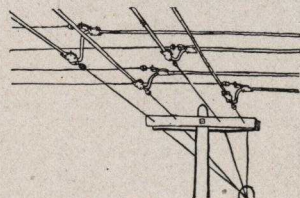


Fig. 20. Making a right angled corner turn where it is not possible or practicable to locate a pole on the corner.

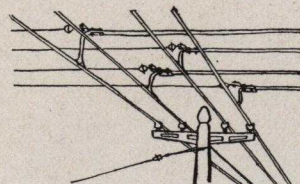


Fig. 21. Showing the methods of holding mid-span tap, in a feeder line by using Matthews Cable Clamps.

See Matthews Deadendeye on page 15



Figure 22

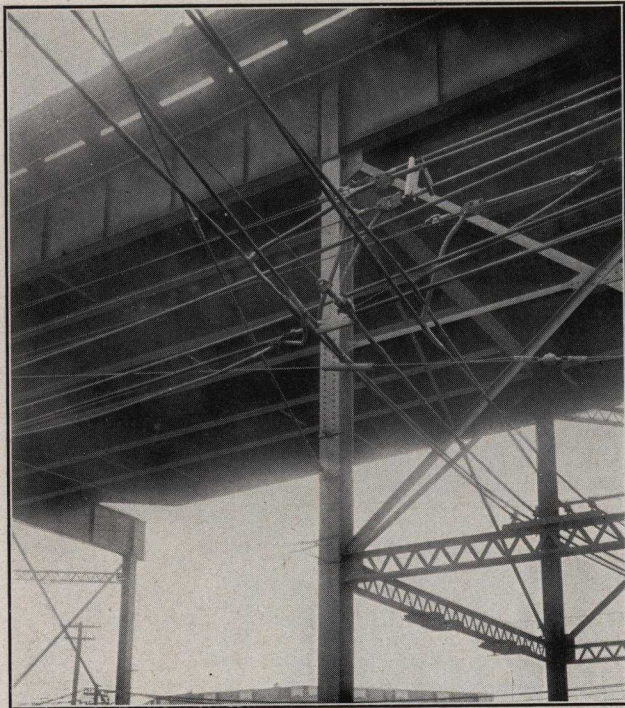


Figure 23

Shows installations of Matthews Cable Clamps, under elevated structure of the subway division of the Interborough Rapid Transit Company, at 176th Street and Boston Road. The size of the cable is 500,000 C. M. This cable has been in service since 1909 and has caused no maintenance charges. The cables supported on the Interborough structures are owned by the Union Railway Company, New York City, Mr. J. G. Kent, E. E. Figure 22 shows the clamp, used as a strain clamp, and also as a support for the cables, which you will note are not attached to the structural steel.

The size of cable shown in Figure 23 is 500,000 C. M. This corner turn is made in the air and could only be accomplished by the use of Matthews Cable Clamps. At this point, the Union Railway Company could not place a pole. On account of the length of the span, which is 170 feet, it was almost impossible to pull the cable taut enough to separate them. This accounts for the block shown in the photograph. This is a temporary installation. The pole originally set at this point was ordered to be moved and at that time the clamps were installed. The installation can not be considered permanent. Considering the length of the span and the size of the cable, this installation of Matthews Cable Clamps should satisfactorily demonstrate their holding power.

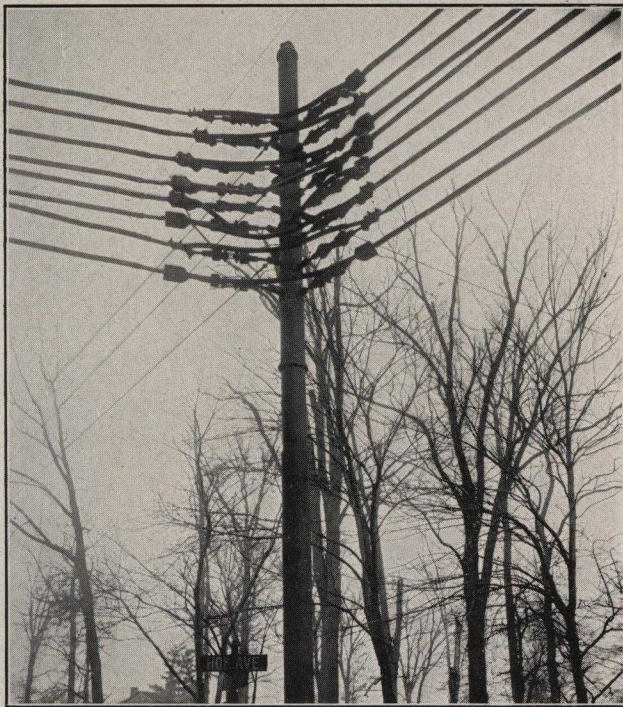


Figure 24

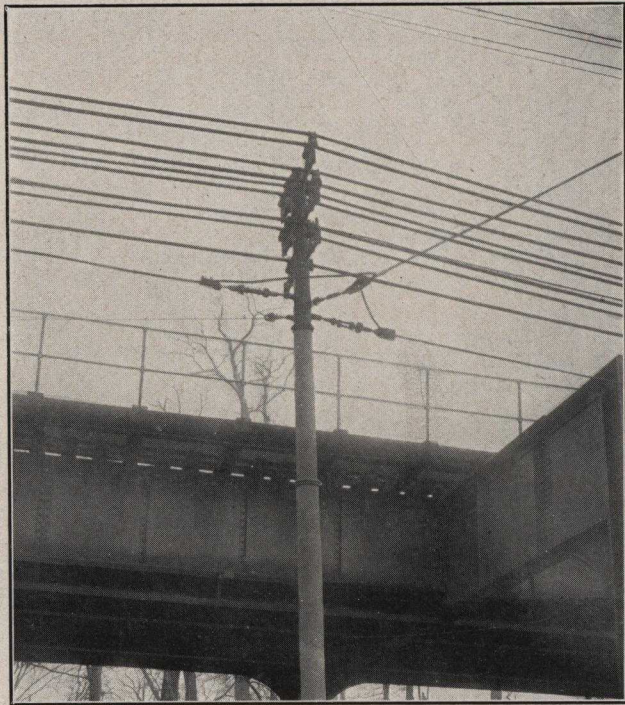


Figure 25

This shows an installation of Matthews Cable Clamps at Boston Road and Hoe Avenue. This is an unique installation on account of the vertical arrangement of the cables on the iron poles, which is somewhat different from the general arrangement of supporting cables on poles. The size of the cable is 500,000 C. M. The removal of the insulation, shown on the left side of the picture, was not caused by an error in the original cutting of the cable, but by the replacing of the pole. This was in 1910 and they were not able to place it exactly on the same spot where the original pole stood. There are no maintenance charges on this installation and the bolts in the clamps have not rusted, as galvanized clamps are used in the installation.

Installation of Matthews Cable Clamps on 4-0 conductors, which shows a right angle turn without cutting the main cable on the right side of the photograph. This also shows the Matthews Cable Clamp used as a strain clamp for a dead-end tap on the left side of the photograph.

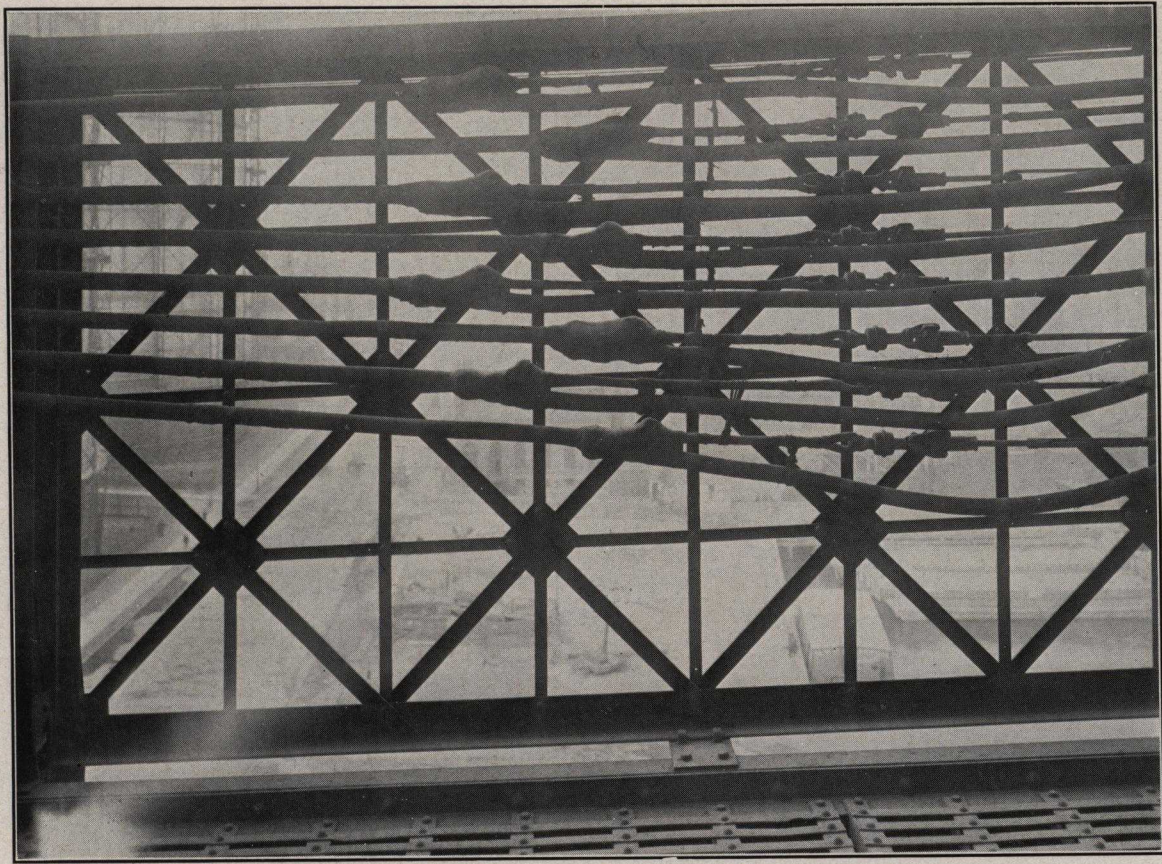


Figure 26

Shows installation of Matthews Cable Clamps on 750,000 C. M. cables, which are supported on the outside railing of the Queensborough Bridge. This bridge extends from the Island of Manhattan to Long Island City. It will be noted that the clamps in this installation are insulated and are installed in a zig-zag manner, so as to take up the least possible space. In this installation they are holding the cables tight on vertical racks, which are placed every fifty feet. The cables are anchored every 200 feet with Matthews Cable Clamps. This installation shows how Matthews Cable Clamps can be used where space is limited.

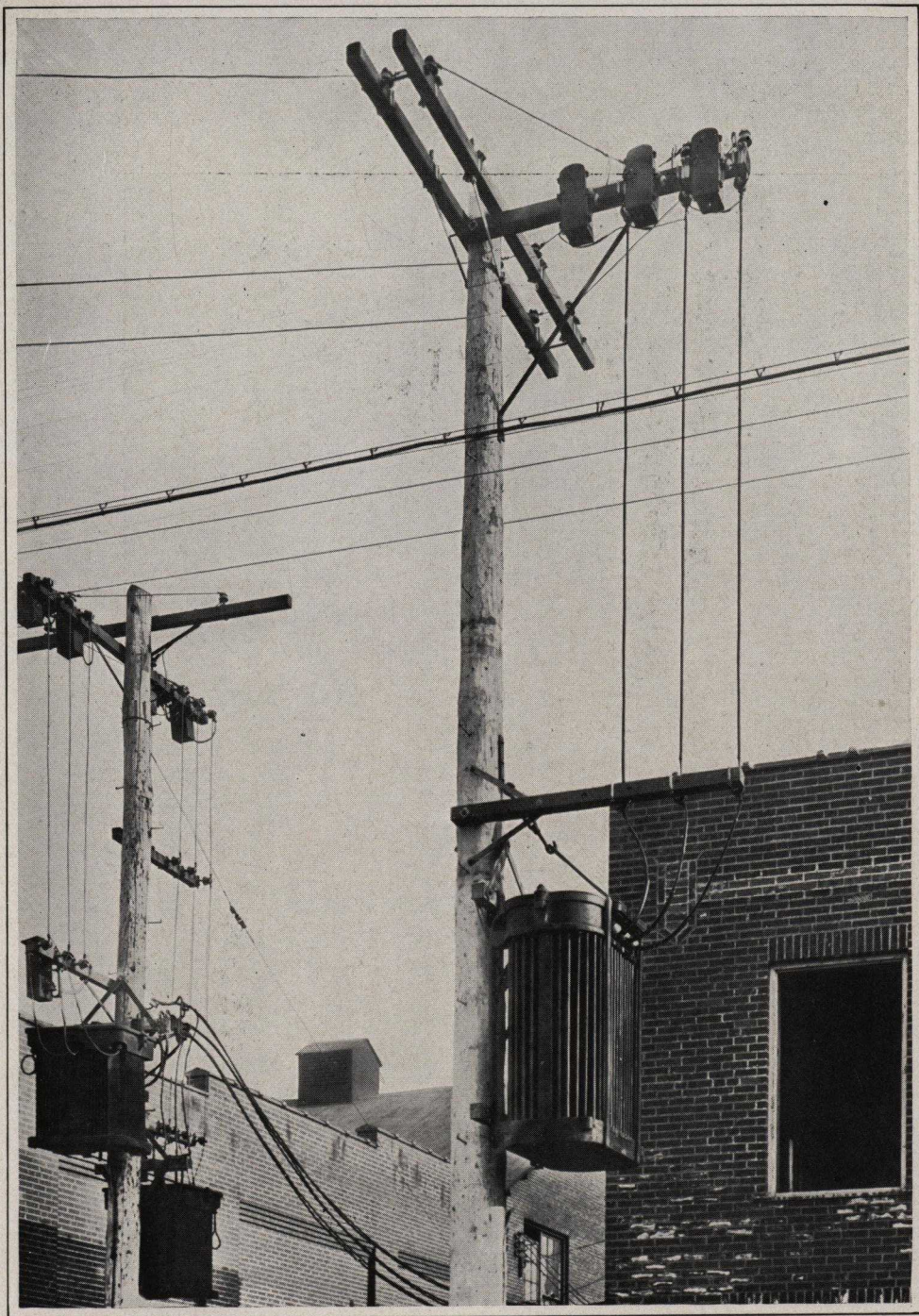


Figure 1

Matthews Fuse Switches, Type A, protecting 150 K. W. 3-ph. transformer at the Banner Iron Works, St. Louis. This transformer replaces the two transformers on the left of the picture, which, you will note, are also protected by Matthews Fuse Switches.

MATTHEWS FUSE SWITCHES

ADVANTAGES OF THE MATTHEWS FUSE SWITCH ON STAR CONNECTED FOUR WIRE 2300-4000 VOLT SYSTEM

In a star connected four wire system the primary neutral is always grounded, which leaves a maximum potential between the phase wires and the ground of 2,300 volts. When any one of the phase wires comes in contact with another wire that is grounded, it acts the same as a short-circuit, causes a rush of current to the point of contact, burning off the wire, causing it to fall in the street. The result of this is that the heavy flow of current to the ground through this wire makes it impossible to keep the feeder, to which this wire is connected, in operation. It becomes necessary to open the switch on the feeder in the power house and throws the entire section out of service until this broken wire which is grounded has been located and repaired. (See page 136.)

The Matthews' Fuse Switch connected on this wire where it attaches to the feeder will eliminate this fault because the rush of energy to this defective wire will burn out the fuse in the Matthews' Switch. The result will be that the system will be immediately cleared, the feeder will continue to operate, but the particular section served by the defective wire will be out of service, resulting in many calls of "Lights out," etc. This will be a direct notification to the company as to the location of the Matthews' Fuse Switch that is protecting these customers. A troubleman will be immediately dispatched to this fuse switch. If the fuse is found to be blown, the troubleman will examine the line, repair the fault, replace the fuse and restore the service. (See pages 197 to 199.)

If this condition should occur on a very bad day during a heavy rain storm, or if the poles were wet from other causes, it would be quite impossible for a lineman to handle this wire without extra precautions in the nature of extra heavy rubber gloves, lineman's protectors, blankets, etc., because the moment that he took hold of the wire, the pole being grounded, he would place himself in circuit between the primary phase wire and the earth through the pole, the difference of potential being approximately 2,300 volts through his person.

By the use of the Matthews' Fuse Switch he can first open the blade, remove it from the box, make the necessary repairs, replace the fuse in the box and continue the service without liability to himself or to the company.

Another instance (having in mind this same wire down without the use of the Matthews' Fuse Switch), would leave this wire lying in a position during the time the fault was being located, where some innocent child or some other person having occasion to be on or about the premises would come in contact with this wire and receive serious injuries and possibly be electrocuted. The newspapers, anxious to vend their news to the public, put scare lines in the newspapers about the electrocution, and a repeated number of these accidents soon sets up a clamor for the burying of the wires underground (see bottom of page 96 and page 98). This entails a large expenditure of new capital, because of the scrapping of a large amount of capital investment represented by the overhead distribution system.

ADVANTAGES OF THE MATTHEWS FUSE SWITCH ON DELTA, SINGLE OR TWO-PHASE SYSTEMS

On the delta, single or two-phase systems the faults are not quite so bad as those mentioned above, as these systems are operated generally free from grounds on either side of the primary. Grounds, however, do occur by coming in contact with trees, foreign wires, etc., which causes a rush of energy to ground, and if there is a Matthews' Fuse Switch installed in this circuit, the rush of energy, if sufficiently large, will cause the fuse to blow.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



MATTHEWS FUSE SWITCHES

The Matthews' Fuse Switch on this system has the advantage of permitting the troubleman or lineman to "kill" a section of the system to make the necessary repairs, caused by storms and other faults, without interfering with the feeder to which this particular main is connected. It also permits the lineman or troubleman to make repairs in absolute safety, because it is possible for him to kill the line in trouble.

Of course where the Delta, single-phase or two-phase non-grounded systems are employed, then it becomes necessary to use two or more Matthews' Fuse Switches, depending on the number of wires on the particular branch main. (See page 136 for diagrams of these systems.)

ADVANTAGES OF THE MATTHEWS FUSE SWITCH ON LARGE SINGLE AND THREE-PHASE TRANSFORMERS

In this character of work, porcelain fuse blocks are at a disadvantage because when the fuse melts it generally causes a film of molten metal to form over the non-conducting surface and permits a recurrent surge to the faulty transformers, burning up the fuse blocks, charring the pole and burning the cross arms, etc. The Matthews' Fuse Switch is recommended for this character of service, because it eliminates all of these faults. (See page 94.)

MATTHEWS FUSE SWITCHES INCREASE THE EFFICIENCY OF YOUR SERVICE AND PREVENT ACCIDENTS AND DEATHS DUE TO ELECTRIC SHOCKS FROM FALLEN WIRES

The cases cited below are not very unusual. It is such pathetic cases as these that are the joy of the sensational newspapers. They first print the news in scare-head lines, then some editorials on the need for putting all wires underground, etc., etc. Then the citizens form The Blankville Underground Association, and have the city fathers pass a bill—well, Matthews' Fuse Switches on your lines will not only prevent a large part of this clamor, law suits, etc., but will also increase the efficiency of your service and save you money.

CASE 7. CITY'S LIABILITY FOR INJURIES FROM BROKEN WIRE IN STREET*

A child of four years and five months old came in some manner, not known, in contact with a broken wire which was hanging from a city's electric light pole and received the current through her body. The poles were set between the sidewalk and the curb on a grass plot or lawn intended for ornamental purposes and it was on this lawn the child was found. Her left hand, with which she seemed to have had hold of the wire, was so severely burned that it was found necessary to amputate the first two fingers entirely and part of the third. For this injury she sued the city. It was held that a child of her age was not chargeable with contributory negligence either as a matter of fact or as a matter of law. The ornamental grass plot was a part of the street and the child was not a trespasser by going upon it. There was nothing to show that the child had been meddling with the wire. A small burn on her head lent some color to the theory that she might first have touched it with her head, not having noticed it. The plaintiff claimed negligence on the part of the city in constructing and maintaining its wires in such a way as to permit the wire to come in contact with the branches of a tree so that the insulation was destroyed by abrasion against the tree, and the wires coming in contact therewith when it was very wet, a short circuit was formed causing the wires to burn off. It was held that the question of the city's negligence was for the jury, and the evidence was sufficient to sustain a verdict holding it liable. *Johnson vs. Bay City, Michigan Supreme Court, 129 N. W., 29.*

When wires become short circuited, a Matthews' Fuse Switch protecting this wire is designed to open the circuit in trouble by the fuse melting from overload, killing the section short circuited.

*Case 7 is one of forty-two similar cases that are described in a pamphlet called "The Legal Side," which will be sent on request.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



FIGURE IT OUT YOURSELF

From New Bedford Mercury

BOY ELECTROCUTED

From Saratoga Springs Sun. Sept. 19, 1913

WORKMAN ELECTROCUTED

From Toledo Blade, Sept. 20, 1913

Husband Electrocuted

WIFE SUES FOR \$50,000.

From Salt Lake City News, Sept. 2, 1913

LIVE WIRE KILLS ALBERT SHOWELL

SHOCK WILL COST MAN'S HAND

From Chicago Tribune, Sept. 17, 1913

Teamster Sees Horses Electrocuted

From Brooklyn Eagle, Sept. 26, 1913

Electric Shock Defers Wedding

From New York City World, Aug. 30, 1913

GIVES HIS LIFE SAVING MANY FROM LIVE WIRE

Man Shoves Children Back
From Deadly Strand, Then
Touches It and Dies

From New York City Press, Oct. 8, 1913

100 in Panic when Power Wire Kills

THESE ARE JUST A FEW OF THE 351 CLIPPINGS SENT US IN 1913 FROM ALL OVER THE UNITED STATES. IN MANY OF THESE CASES MATTHEWS' FUSE SWITCHES WOULD PROBABLY HAVE PREVENTED THE ACCIDENT.

On June 1, 1914, the following companies had ordered 50 or more Matthews Fuse Switches:

* UNION ELECTRIC LIGHT AND POWER CO.....	ST. LOUIS, MO.
MILWAUKEE ELECTRIC RY. & LIGHT CO.....	MILWAUKEE, WIS.
COMMONWEALTH POWER CO.....	{ JACKSON AND KALAMAZOO, MICH.
† PUBLIC SERVICE CO. OF NORTHERN ILLINOIS.....	CHICAGO, ILL.
‡ NORTHERN INDIANA UTILITIES CO.....	CHICAGO, ILL.
‡ CENTRAL ILLINOIS PUBLIC SERVICE CO.....	MATTOON, ILL.
LACLEDE GAS LIGHT CO.....	ST. LOUIS, MO.
TEXAS POWER & LIGHT CO.....	DALLAS, TEXAS.
FALL RIVER ELECTRIC LIGHT CO.....	FALL RIVER, MASS.
BELMONT ELECTRIC LIGHT DEPARTMENT.....	WAVERLY, MASS.
HOUSTON LIGHTING & POWER CO.....	HOUSTON, TEXAS.
NORTHERN INDIANA GAS & ELECTRIC CO.....	HAMMOND, IND.
ELECTRIC COMPANY OF MISSOURI.....	WEBSTER GROVES, MO.
CENTRAL ILLINOIS LIGHTING CO.....	PEORIA, ILL.
BOARD OF WATER WORKS ELECTRIC LIGHT COMM.....	LANSING, MICH.
ROANOKE RAILWAY & ELECTRIC CO.....	ROANOKE, VA.
WAUKESHA GAS & ELECTRIC CO.....	WAUKESHA, WIS.
EAST ST. LOUIS ELECTRIC RAILWAY & LIGHT CO.....	EAST ST. LOUIS, ILL.
OHIO VALLEY ELECTRIC RAILWAY CO.....	HUNTINGTON, W. VA.
KANSAS CITY ELECTRIC LIGHT AND POWER CO.....	KANSAS CITY, MO.
INDIANAPOLIS LIGHT, HEAT AND POWER CO.....	INDIANAPOLIS, IND.
FLINT ELECTRIC COMPANY.....	FLINT, MICH.
ELECTRIC LIGHTING DEPARTMENT.....	CITY OF CLEVELAND, OHIO.

* This company had 2,175 Type A and six Type H Matthews Fuse Switches June 1, 1914.

† Insull Properties in small towns in Northern Illinois.

‡ Insull Properties in small towns in Northern Indiana.

‡ Insull Properties in small towns in Central Illinois.

Up to above date over 8,000 Matthews Fuse Switches had been sold.

In addition to above 41 companies had ordered 25 to 50 Matthews Fuse Switches.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

RULES FOR INSTALLING MATTHEWS FUSE SWITCHES

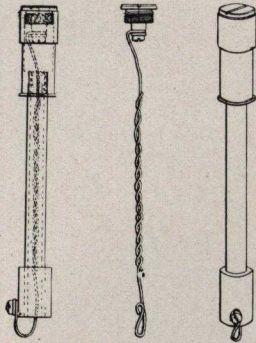


Figure 2

Showing methods of fusing
Types A and B

1. Hang securely on cross arms and see that hangers fit. When it is necessary to hang on metal cross arms or other metal structure, it should be mounted on porcelain insulators.

2. Always arrange the door fastenings so that door will swing away from operator.

3. Before installing the fuse cartridge examine it carefully to see that the aluminum fuse wire is correctly attached thereto. It must be single strand inside of brass explosion chamber of the fuse cartridge and double strand twisted the full length of the fibre tube and single strand from the end of the fibre tube to the contact screw at the lower outside end of the fuse cartridge (see accompanying drawings). The reason for this method of attaching the fuse wire is as follows: A fuse wire will always melt at the point where it gets hottest first. In the above method of connecting the fuse it will melt in the single stranded section in the brass explosion chamber of the fuse cartridge, because all of the heat is retained in this closed chamber while it is thrown off at the outside single stranded end which is exposed to atmospheric temperature; where it is double stranded, it can't melt as soon as where it is single stranded. The reason for having it single stranded outside of the cartridge is so that it will cut off instantly when the explosion occurs. If the fuse wire is double on the outside the explosion will not cut it off and it will swing over to the side of the box, causing it to become alive for a moment.

4. Be sure that the large end of the fuse cartridge is uppermost, so that the explosion will always be downward.

5. Matthews Type A Fuse Switches are shipped with the door handle lock, the hinge pins and the cross-arm hangers wrapped up inside the box. The reason for this is to prevent loss in transit. The insulators for the Types B and F Matthews' Fuse Switches are wrapped up and placed inside the box to prevent breakage in shipment.

6. It will be seen, that to change the door to open right to left instead of from left to right, it is only necessary to change the hinge pins. This can be done on the job in less than five minutes. This does not apply where boxes are specially ordered to open one way only.

DIRECTIONS FOR OPERATING MATTHEWS FUSE SWITCHES

Get a short wooden handle (about 30 inches long). One end of this handle should be made square for about 6 inches of its length. On the squared end attach the hook which you will find in the box. The end of the stick should be made so that it will fit loosely into the square loop on the fuse carrier, as shown in photographs and drawings on pages 100 and 101. You will see the purpose of this stick in Figures 1 to 6.

By its use it is absolutely unnecessary for your men to touch the box in order to take out or install the fuse carrier. The latch on the door is thrown up as shown in Figure 1. The switch blade or fuse carrier is disconnected as shown in Figures 2, 3, 4 and 5. The fuse cartridge is removed from carrier as shown in Figure 6. It is re-fused as shown above. When trouble is cleared, the operations 1 to 6 are reversed, and the line is again connected through the switch with absolute safety to the men who follow these instructions.

(See page 136.)

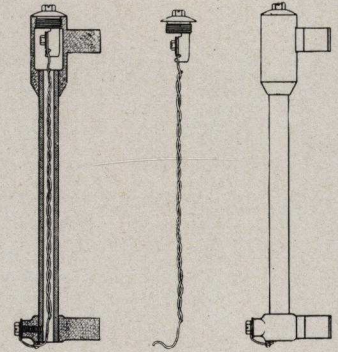
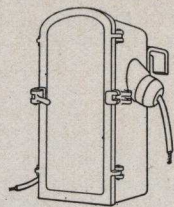


Figure 3

Showing methods of fusing
Types F and H

W.N.MATTHEWS AND BROTHER, Inc. ST. LOUIS U.S.A.





Box ready to be dropped
over cross arm



Figures 4 and 13

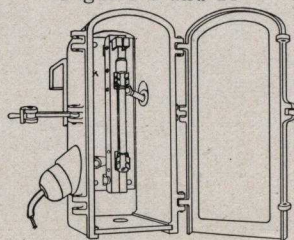
By following these pictures
through from 4 to 13 you will
understand the whole procedure — —



Figures 5 and 12
— — necessary for the re-fusing of a Type
A or B Matthews Fuse Switch.
It is unnecessary to touch the box.



Figures 6 and 11

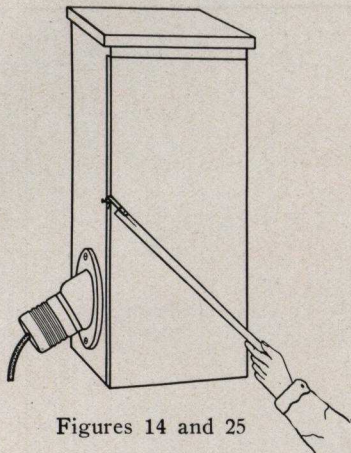


Showing inside details

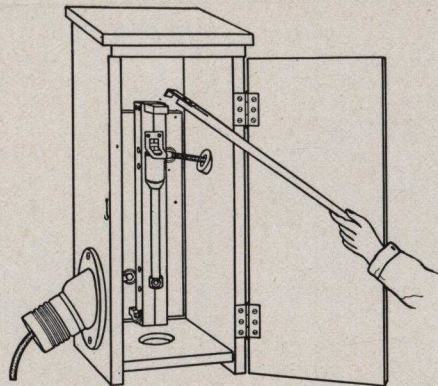


Figures 7 and 10

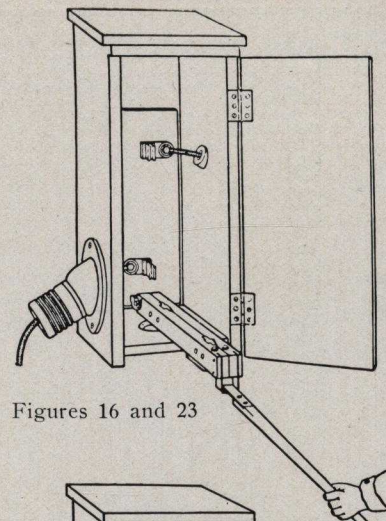
Figures 8 and 9



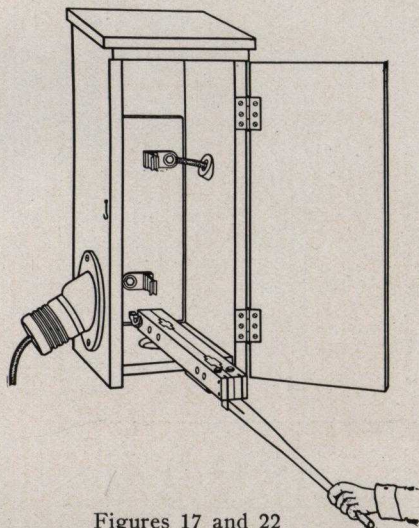
Figures 14 and 25



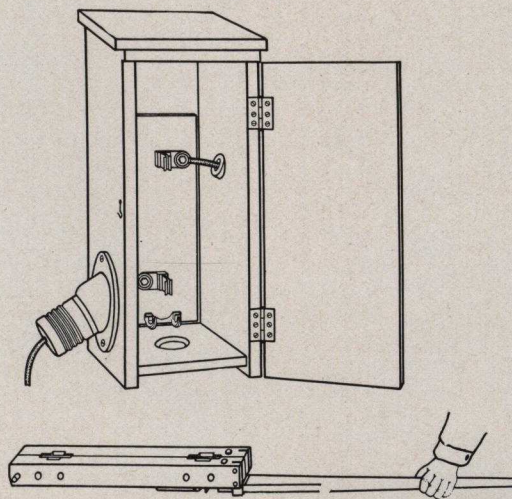
Figures 15 and 24



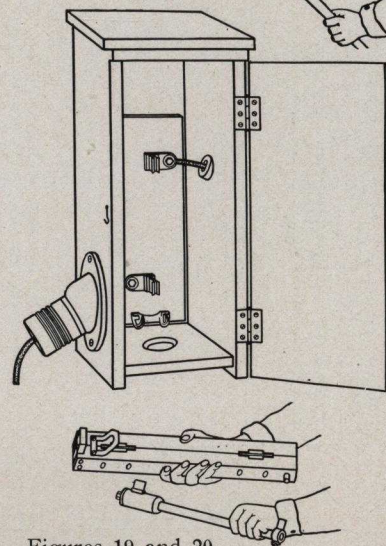
Figures 16 and 23



Figures 17 and 22



Figures 18 and 21



Figures 19 and 20



SAFETY ● FIRST

SOME DON'T'S FOR THOSE WHO OPERATE Matthews Fuse Switches

NUMBER ONE

DON'T hang a Matthews Fuse Switch on a cross arm so that when the door is opened it will be between you and the box. Fix the door so that it will open away from the pole. You can do this on the job in two minutes.

NUMBER TWO

DON'T fuse the cartridge in Matthews Fuse Switch with anything but Aluminum fuse wire. It is more positive than zinc alloy or other kinds of wire. The manufacturers can furnish it immediately from stock at reasonable prices.

NUMBER THREE

DON'T double the fuse wire all the way through the cartridge from terminal to terminal. Fuse wire should be single at both ends and double in the middle. (See Directions).

NUMBER FOUR

DON'T connect live side of the line to the lower terminal of a Matthews Fuse Switch.

NUMBER FIVE

DON'T attempt to open a Matthews Fuse Switch with your bare hands. Use a hooked stick similar to that shown in the hands of the lineman in the drawings below. Note that he does not find it necessary to touch any part of the box or switch with his hands until he has completely disconnected the current from the box.

NUMBER SIX

DON'T attempt to operate Matthews Fuse Switches unless you have read the directions and thoroughly understand them. This holds true of all high voltage apparatus. A disregard of this "Don't" may result in a serious accident to you. Know about the operation of every device on your poles before you climb them. The top of the pole is a poor place to learn.

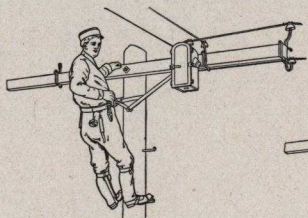


Fig. 1.
Lineman in proper position to operate a Matthews Fuse Switch.

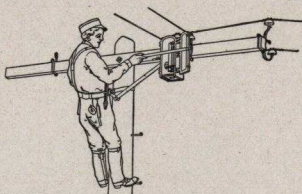


Fig. 2.
Opening door with his hooked stick.

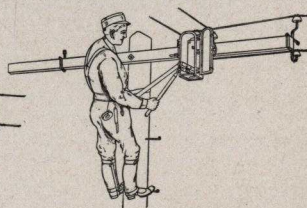


Fig. 3.
Disconnecting switch is pulled down with hooked stick.

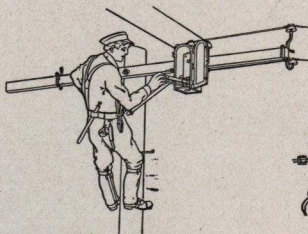


Fig. 4.
Removing switch blade with fuse cartridge on it.

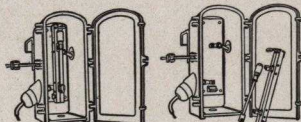


Fig. 6.
Figures 6 and 7 show the details of Matthews Type A Fuse Switch. Figure 6 shows all parts together, and Figure 7 shows cartridge and switch removed.

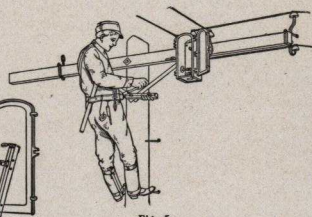


Fig. 5
Shows way to remove cartridge to refuse it. Note that his position on pole is always away from box.



WILLIAM R.P.A. BUREAU

All users of Matthews Fuse Switches are furnished any number of these cards that they want to hang up in conspicuous places where the men congregate. Actual size, 11 x 17 inches.

DO YOU SHUT DOWN THE WHOLE TOWN IN CASE OF FIRE, OR ARE YOUR LINES SECTIONALIZED SO THAT YOU CAN CUT OUT ANY SECTION AFFECTED?

READ LETTER No. 1 FROM MR. R. M. HOWARD BELOW:

Number 1

HOWARD MORRIS
RECEIVER WINONA RAILWAY AND LIGHT CO.

WINONA, MINN., Jan. 13, 1913.

GENTLEMEN:

Replying to yours of the 9th regarding the merits of Matthews' Fuse Switches.

On our heavy circuits we experienced a good deal of trouble and interruption to service on account of the plug type of fuse blowing to pieces under short circuit conditions, and so have adopted the Matthews' Fuse Switch as our standard on all primary circuits where it is necessary to use fuses heavier than 30 amperes.

We consider that the Matthews' Fuse Switch makes a permanent installation, and the switch feature appeals to us very much, especially in the business district. We have loaned the Chief of the Fire Department one of the switches, and he has instructed all of the firemen with regard to opening these switches in case of fire, so that in a case where our troublemen do not get on the ground before the firemen, they can open the switches and cut out the current in the building where the fire started. As we have several customers who have 2200 volt primary motors, we consider that this feature alone justifies the expense of the Matthews' Fuse Switches.

We attach a cord to the ring in the top of the switch and put in a porcelain strain insulator with a cord below the insulator so that the firemen can pull the switch without having to carry an insulated hook such as the linemen use. The Chief of the Fire Department is very favorably impressed with the switch and this method of operation, and it is our intention to equip our entire business district with these switches and remove all of the porcelain plug fuses.

Very truly yours,

R. M. HOWARD,
Gen. Mgr. for Receiver.

RMH.K

Number 2

WATERTOWN GAS & ELECTRIC COMPANY.

WATERTOWN, WIS., July 5, 1913.

GENTLEMEN:

In reply to your various letters, we are pleased to advise that we have purchased a number of your Matthews' Fuse Switches and that they are giving entire satisfaction.

Yours truly,

A. C. RENTELEE,
Chief Clerk.

AR-S

Number 3

KENTUCKY ELECTRIC COMPANY.

LOUISVILLE, KY., Jan. 14, 1913.

GENTLEMEN:

Referring to your letter of the 9th inst., we wish to say that we have used Matthews' Switch Boxes up to 75 amperes and have found them satisfactory.

Yours very truly,

G. M. MILLER,
Supt. of Distribution.

GMM/JL

Number 4

PEORIA GAS AND ELECTRIC COMPANY.

PEORIA, ILL., Jan. 14, 1913.

GENTLEMEN:

We believe that the Matthews' Fuse Switches are valuable for our work, because when the fuses blow they do not burn up the entire cut-out or any part of it, and when a fuse is to be replaced the work can be done with entire safety to the linemen.

Yours very truly,

L. OWEN,
Supt. Electric Dept.

LO-FW

Number 5

PEOPLE'S GAS & ELECTRIC CO.

MASON CITY, IOWA, Jan. 11, 1913.

GENTLEMEN:

We have your favor of the 9th relative to the Matthews' Fuse Switch, and in reply would say that the writer considers this fuse switch a high-grade article, and has used it extensively, although I prefer to have it mounted in the wood box instead of the iron case. It is very convenient for opening the primary lines, for which purpose it may be used with entire safety.

Yours truly,

M. ANDERSON,
General Manager.

MA-LEV.

Number 6

LOUD DEVELOPMENT.

HALE, IOSCO CO., MICH., Jan. 15, 1913.

GENTLEMEN:

We have your circular or fill-in letters, which have been coming to us addressed to Eastern Michigan Power Company, Oscoda, Mich.; the last one under date of January 9th. These pertain to the Matthews' Fuse Switches. You also sent us a list of people using these switches.

For your information will say that we have some in use now which we procured from Commonwealth Power Company, which we have connections with at Jackson, Mich. Our home office is at Jackson, Mich. We know what Matthews' Fuse Switches are and the importance of using them.

If you care to address us at any time in the future, instead of doing so at Oscoda, make it Hale (Iosco Co.), Mich., which is our proper address.

Yours very truly,

J. F. EATON.

JFE/LAB.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.



OVER 8000 MATTHEWS FUSE SWITCHES WERE IN USE JUNE 1, 1914

Number 7.
THE HELENA LIGHT AND RY. COMPANY.
HELENA, MONT., April 14, 1914.

GENTLEMEN:

Regarding the Matthews' Fuse Switches, we have equipped all of our branch primary circuits with them, and know of nothing which can equal them for their reliability in service. The protection to our men in operating them is another very good feature.

We will not need any of the switches for some time, as we have installed all that we need.

Our maintenance of these switches has been nothing, and conditions indicate that this item will never trouble us.

Yours very truly,
C. A. BERNIER,
Supt. Electric Dept.

Number 8
CAROLINA POWER & LIGHT COMPANY.
RALEIGH, N. C., April 14, 1914.

GENTLEMEN:

We have only six Matthews' Fuse Switches in use at the present time. Three were put in service in the early part of 1913 to protect a bank of transformers in the Commercial National Bank Building. These fuse switches are giving perfect satisfaction, and we shall continue to install them when in need of a combined fuse switch cut-out.

Yours very truly,
JOHN HERMAN,
Supt. Overhead Line at Raleigh, N. C.

JCH

Number 9
PUBLIC SERVICE COMPANY OF NORTHERN ILLINOIS.
NORTH CRYSTAL LAKE, ILL., April 13, 1914.

GENTLEMEN:

This is to advise you that we have had about fifty Matthews' Fuse Switches installed in this district in the last three years. Thirty of these are on single-phase transformers installed on our 8000-volt lines. We have found them very satisfactory on this class of work, as the switches can be opened and work done on transformers with very little danger to the lineman. We have about twenty of these switches installed on three-phase 2300-volt transformer banks, and on three-phase 2300-volt lines where the load is too large for the small porcelain cut-out, and have found them very satisfactory, both as a disconnecting switch and fuse.

Yours very truly,
H. C. WILLARD,
Const. Foreman.

HCW/LF

Number 10
ROANOKE RAILWAY AND ELECTRIC CO.
ROANOKE, VA., April 13, 1914.

GENTLEMEN:

We have your letter of April 7th, asking our opinion on your Matthews' Fuse Switches.

We feel that the fact that we continue to send you repeat orders for this switch speaks for itself.

Yours very truly,
W. G. CLAYTON,
Supt. L. & P. Dept.

WGC.B.

Number 11
THE MILWAUKEE ELEC. RY. & LIGHT CO.*
MILWAUKEE, Wis., April 10, 1914.

GENTLEMEN:

Your letter of April 7th received, and in reply thereto, we wish to state that your Matthews' Fuse Switches are giving good satisfaction, and that our continued use of them is evidence of this fact.

Yours very truly,
G. G. POST,
Electrical Engineer.

GGP/O

Number 12
INDIANAPOLIS LIGHT AND HEAT COMPANY.
INDIANAPOLIS, IND., April 10, 1914.

GENTLEMEN:

Replying to yours of the 7th inst., beg to say that we have recently installed a set of Matthews' Fuse Switches and believe we will find them to be very much to our liking.

We will keep some track of them and report to you later.

Very truly,
THOS. A. WYNNE,
Vice-Pres.

TAW/M

Number 13
GREENVILLE MUNICIPAL PLANTS.
GREENVILLE, TEX., April 10, 1914.

GENTLEMEN:

The Greenville Electric Light & Power Plant have been using the Matthews' Fuse Switches for some time.

It gives me pleasure to state that they are the best I have ever used; in fact, the best I have ever seen in use, both for safety and durability.

Respectfully,
M. M. ARNOLD,
Alderman No. 1.

MMA:MH

*This company had 600 type A and 15 type H, May 1, 1914.

(See page 136.)

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



MATTHEWS CABLE

Manufactured under

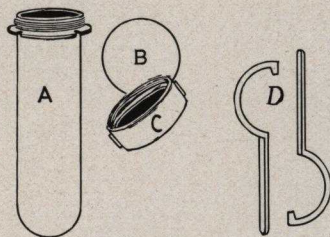


Figure 1

SPLICING JOINTS

Hargis Patent—Number 802337

DESCRIPTION OF PARTS

The illustration above shows the parts of a Matthews' Joint and the Spanner Wrenches.

A—Closed Lead Sleeve and Externally Threaded Brass Collar.

C—Internally Threaded Brass Collar.

B—Lead Disk or Gasket.

D—Spanner Wrenches for Closing Joint Tightly.

THE CHIEF REASON FOR THE PRODUCTION OF THE MATTHEWS WIPED JOINT

The chief reason for the production of the Matthews' Joint is that by its use the conductors in a cable splice are always accessible for changes or tests. It is frequently necessary to open cable splices for the purpose of making tests in locating trouble, or for the purpose of changing the conductor assignments due to changed plans of distribution.

In order to open an ordinary splice it is necessary to remove the lead sleeve and afterwards replace it by the necessary wiped joints. With the Matthews' Joint it is only necessary to unscrew the sleeve which exposes the cable conductors, without in any way altering the wiped joint. Tests made on a splice joining two twenty-five-pair cables and carrying also a fifteen-pair tap cable have shown that the time of changing the conductor assignments of the fifteen-pair tap cable was, with the Matthews' Joint, approximately one-fourth of that required in the joint made in the regular way and containing similar cables. In making this comparison, the time of tagging the conductors, which would be common to both splices, has been omitted. To this saving in time in favor of the Matthews' Joint should be added the further saving due to the fact that less material is required in making the change in the Matthews' Joint than in the regular splice. In the Matthews' splice the material required would be the paraffine and gasoline necessary to boil out the splice. In the regular splice there would be the solder, a greater amount of paraffine and gasoline and perhaps a new lead sleeve.

HOW TO MAKE A MOISTURE-PROOF MATTHEWS JOINT

When installing cable the ends should overlap about 24 inches and should be bent down in a gradual curve, as shown in Fig. 2, page 106.

After the cable ends are bent down, take a knife and cut all around the lead casing of both cables about 5 inches below the bend. This is called "scoring" and is done so that the lead casing can be broken at the point scored. (See Fig. 3.)

Scrape the cable clean with a shave hook or pocket knife, making it look bright all around on both cables, 3 or 4 inches above the point of the scoring. This is done as shown in Fig. 4, so that the solder will stick to the lead casing of the cable.

Lead becomes dull soon after it has been scraped. By rubbing the tallow of a candle over the scraped parts they will remain bright and the solder will stick. The tallow will act as a flux for the solder. (See Fig. 5.)

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





Figure 2



Figure 3



Figure 4



Figure 5



Figure 6



Figure 7



Figure 8

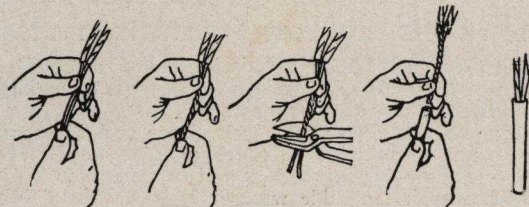


Figure 17

The best sleeve to use is $\frac{1}{8} \times 3$ inches made of muslin

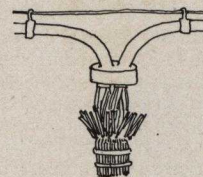


Figure 14



Figure 9



Figure 10



Figure 11



Figure 12



Figure 13



Figure 15



Figure 16

The lead gasket having been previously bored with a wood auger or knife, so that the two cable ends will fit snugly into the holes, it is slipped over the cables and moved up to about 1 inch above the point where the cables were scored. It must be scraped bright and tallowed same as cables. The brass collar is then put on with the flange up and the threaded part down. (See Fig. 6.)

Fasten the lower ends of the cables together with a string or wire so that they can not move apart. Use a stick of wood in the shape of a long tapering wedge and place it between the cables so that the brass collar, when in proper position, will set securely on the wedge. (See Fig. 7.)

The solder is poured into the cup formed by the lead gasket and the brass collar. The solder should be poured in slowly first around the outside edge of the gasket and then between the gasket and the cables. As soon as the cracks between the gasket and brass collar and the gasket and cables are completely filled, the cup may be filled to any desired amount. Always pour solder against the wiping cloth and let it drop from cloth into the cup. (See Fig. 8.)

After this operation is finished, the solder will have a rough appearance, but will be absolutely moisture-proof. If done as directed the irregularities may be easily smoothed out by keeping the solder hot with a blow torch and using the wiping cloth as shown in Fig. 9. Care must be used not to melt the cable sheathing with the flame of the blow torch. This can be prevented by putting stickers on cable.

To take off the lead casing, bend the cable ends back and forth in all directions; the cable will crack where it was scored and can be pulled off without any further cutting. (See Fig. 10.)

The paraffine having been prepared, the exposed wires are boiled out by submerging them in a pot full of the hot liquid. This is done to drive out any moisture that may be in the cable ends. (See Fig. 11.)

The wires are all cut even with a pair of snips. They are then bent out of the way as shown in Fig. 11. The actual splicing is done by removing some of the paper insulation and twisting the bare wires together. A muslin tube is put over the twisted or spliced wires to insulate them from the others. Always splice red to red and blue to blue. (See Fig. 17.)

After all the pairs are spliced the muslin tubes should hang down at about an equal distance from the brass collar. The spliced wires will appear too large in bulk to be enclosed in the lead sleeve. (See Fig. 13.)

To overcome this, half of the pairs (the inner half) are arranged neatly and laced. The outer half are bent up and arranged around the wires of the inside pairs. They are then laced tightly by using white muslin tape. All of the splice can then be easily enclosed in the lead sleeve. (See Fig. 14.)

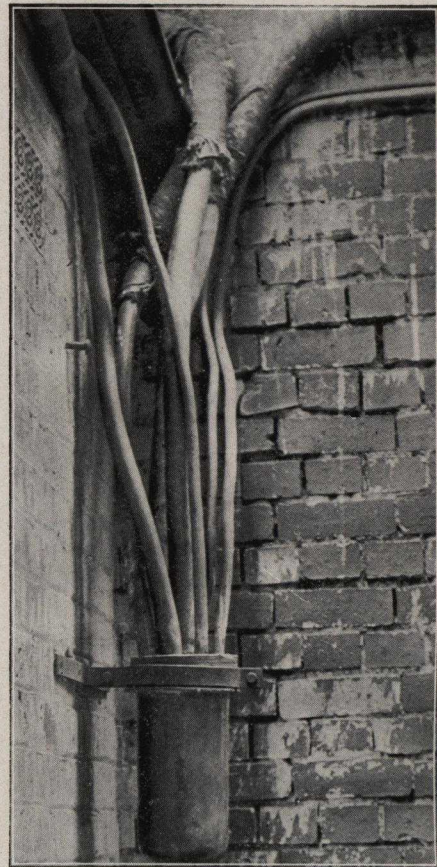
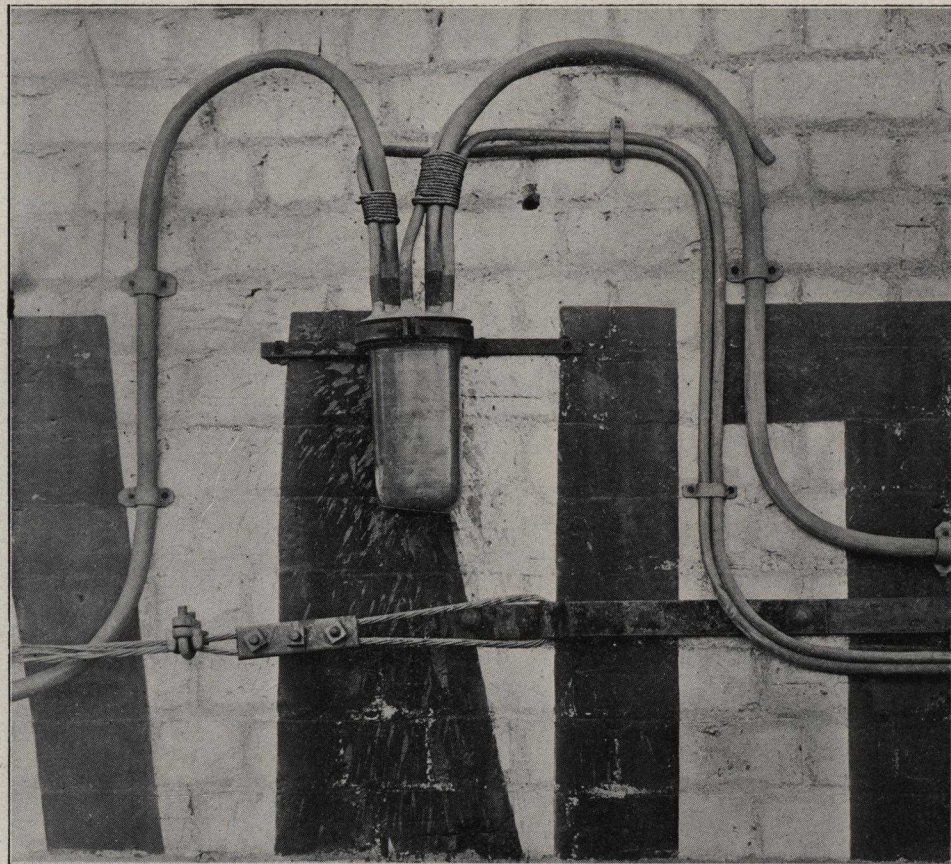
Fig. 15 shows the laced pairs. Before the sleeve is attached the splice should be again submerged in the hot paraffine to be absolutely certain that no moisture is left in the spliced wires.

The best method of making the threads of the collar absolutely moisture-proof is to coat them with red or white lead. After this is done screw the sleeve into the collar tight by means of the spanner wrenches, as shown in Fig. 16. If the brass collar, lead gasket and sheath of the cables have been properly tinned as directed above, so as to hold the solder and make the joints tight, moisture can not enter. In case it becomes necessary to enter the joint later for inspection, etc., it is an easy matter. In case the sleeve does not unscrew easily, *warm* brass collar with a blow torch or hot soldering iron and it will come off quite easily—care must be taken not to make it so hot as to loosen the solder.

We now have a completed Moisture-Proof Matthews' Joint in a 2-way splice. The sleeve can be unscrewed at any time, tests made and multiples changed. This joint can be made by any intelligent workman at a smaller cost than the old-style horizontal wiped joint and will save its cost many times, because of its accessibility and convenience as a test point or for changing multiples, etc.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.





Showing Matthews Cable Splicing Joints as used by the Post and Telegraph Department of the Union of South Africa,
in Johannesburg, S. A.

METAL FOR SOLDERING MATTHEWS JOINTS

A good metal for soldering Matthews Cable Splicing Joints is made of 60 per cent lead and 40 per cent tin. Care must be taken in regard to the heat of the solder, because if it is used too hot it will melt the lead casing of the cable; if it is not hot enough it will not stick to the cable. In order to find out if the solder has the proper heat, take a piece of newspaper and dip it into the solder from time to time while it is being heated. As soon as it has reached proper heat it will set fire to the newspaper.

THE WIPING CLOTH

The wiping cloth should be made of a good grade of Herring-bone ticking and be thoroughly boiled in beef fat or tallow. Then the cloth should be rubbed against some rough surface, such as brick or smooth stone, until all the "nap" is off. This is necessary, because if any "nap" is left on the cloth the solder will stick to it. After the cloth is once broken in or "seasoned," as it is called, all that is necessary is an occasional paraffining. When the cloth is burned through on one side, do not throw it away, but fold it in such a manner that a new surface is presented. In this way you get the use of the whole cloth. Always warm the cloth before beginning to make a wipe, otherwise the temperature of the cloth has a tendency to lower the temperature of the solder.

PARAFFINE

Paraffine is used after the joint has been soldered, because when it is hot it becomes liquid and will drive out all moisture that may be in the cable. As soon as the paraffine comes to a boiling point, take it off the fire; if it gets too hot it will ignite. A good way to test paraffine to find out if it is the proper heat, is to roll a piece of newspaper and dip it into the hot paraffine. As soon as the newspaper chars, it is sufficiently hot. Care must be taken in using hot paraffine, because if it is poured on a cable that has moisture in it, it will fly around and burn the workman.

BLOW TORCHES

Points to Remember:

Use only the best grade of gasoline (74°). Gasoline must be clean and kept in a clean can, otherwise the burner will become clogged. Never try to fill a torch from a big can. A pint or quart receptacle should be used for this purpose. If this is done, the torch can be held in one hand and filled with the other without danger of overfilling or spilling. The torch should be a little more than two-thirds full, so that there will be room for sufficient air to prevent frequent repumping to keep up the pressure.

See that the filler plug is closed tight, to prevent the escape of air from tank. The fibre washer under filler plug must be replaced when worn out. Common washing soap rubbed into all threads and joints will stop all leaks.

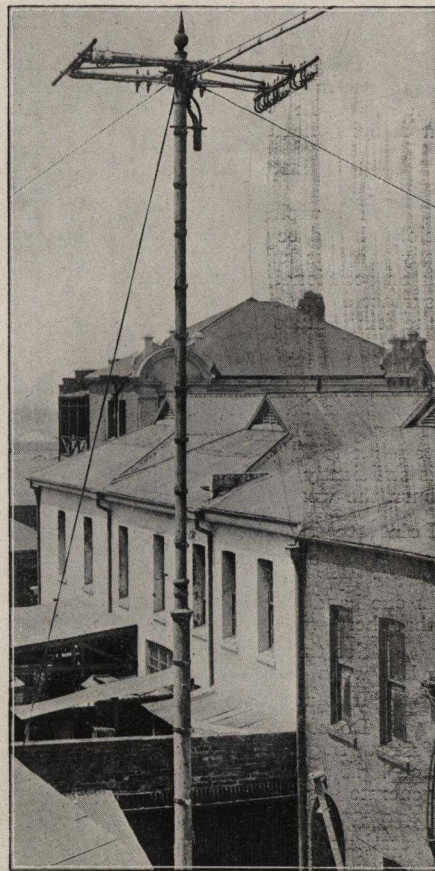
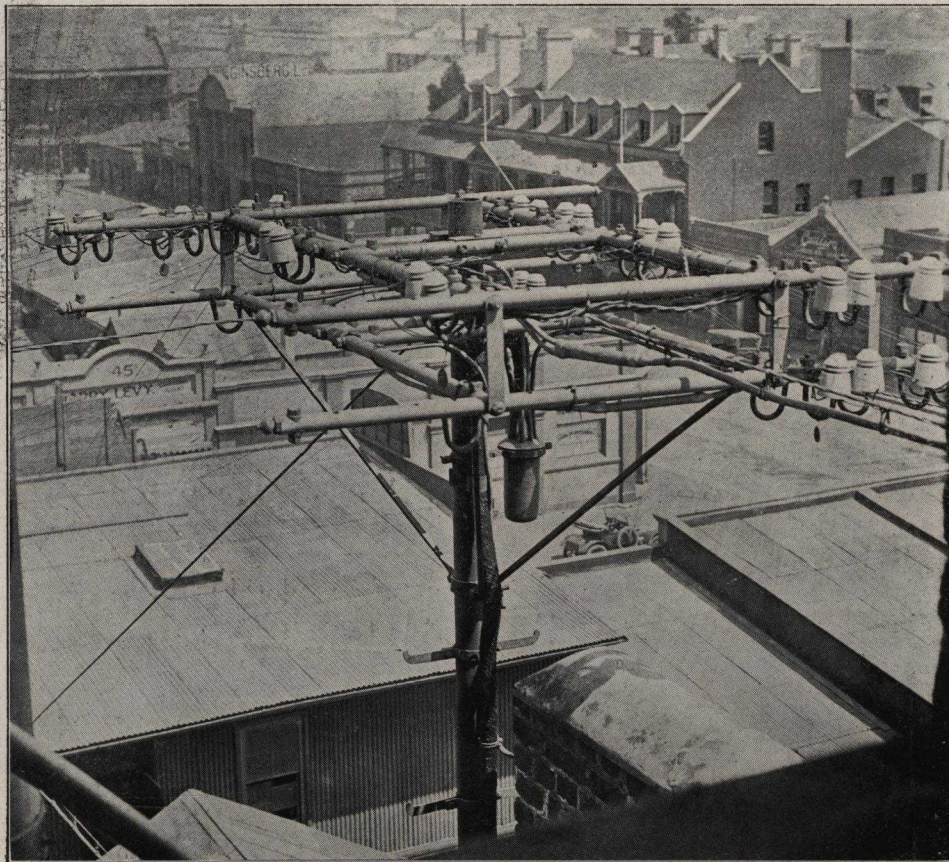
It is necessary to have the pump in good working order; a few drops of lubricating oil well rubbed in will soften the pump washer.

Do not turn needle valve too tight, as there is danger of enlarging the orifice of burner. See that the burner is sufficiently heated when first starting. One filling of the drip cup is generally sufficient if the flame is shielded from draft while heating the burner; if not, fill again and light as before. A long or yellow flame or raw gasoline shooting from the burner shows that the burner is not hot enough to properly generate gas.

When a gasoline torch is used, 90 per cent of the heat goes off without doing any work whatever. When performing most blow torch operations it is easy to save a great part of this heat by making a shield of sheet-iron or asbestos to keep the heat from escaping so easily from the object to be heated.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





Showing Matthews Cable Splicing Joints as used by the Post and Telegraph Department of the Union of South Africa,
in Johannesburg, S. A.

ADVANTAGES OF THE MATTHEWS JOINT

The Matthews' Joint can be made by any cable splicer. It has all the good points of the horizontal joint and none of its bad ones. The complete submersion of the wires in the boiling paraffine is better and does away with the drip pan and waste of paraffine. The Matthews' Joint requires less solder. When a lot of cable is being pulled into the ducts the ends can be quickly soldered into a Matthews' Joint and the more tedious work of splicing pairs can be finished at any time. This does away with the possibility of getting moisture in the cable ends. Any number of pairs can be left "dead" in a Matthews' Joint and can be connected up at a later date. No unfinished joint need ever be left open over night or during damp weather. A straight-away joint may be changed to a branch joint by boring a hole through the soldered top for the entrance of the branch cable. It is then soldered as before and the pairs spliced in.

The Matthews' Joint has but one end to solder. It is on top where it is not only easier to do the soldering, but also easier to examine the work for pinholes or other defects before the splicing of the wires is done.

The Matthews' Joint can be easily inspected or used for a test point by unscrewing the sleeve with the spanner wrenches. Any wire and its mate may be picked out and tagged in less time than in a horizontal joint. Each Matthews' Joint is always accessible to the "troubleman." Matthews' Joints cost less to install and save their cost many times because of their accessibility in time of trouble.

TESTIMONY FROM USERS

Letter No. 1

SAN DIEGO HOME TELEPHONE CO.

1027 Sixth St.

San Diego, California.

JANUARY 8, 1914.

GENTLEMEN:

We have in use throughout our system, a great many of the Matthews' Products, such as anchors, spring joints and boltless guy clamps, and as our experience has been, we highly recommend their use.

We are very much pleased with the performance of your Matthews' Cable Splicing Joints, and have had the best of success with their use, affording a most convenient means of testing.

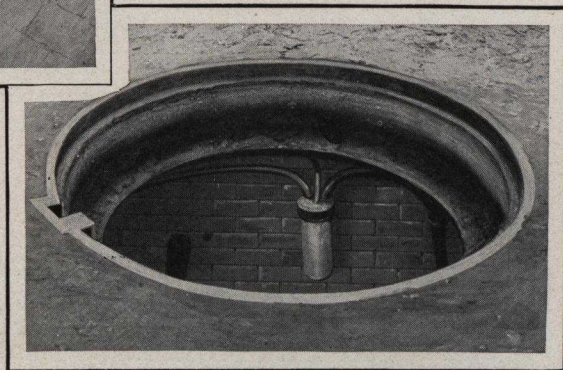
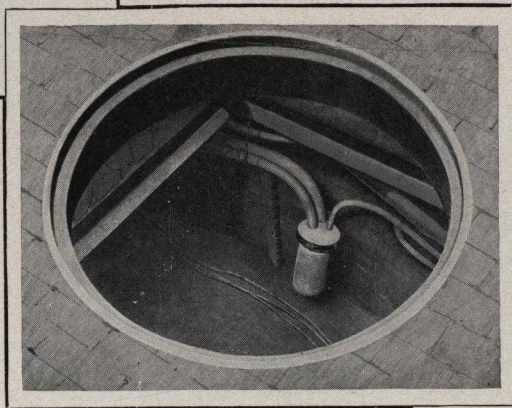
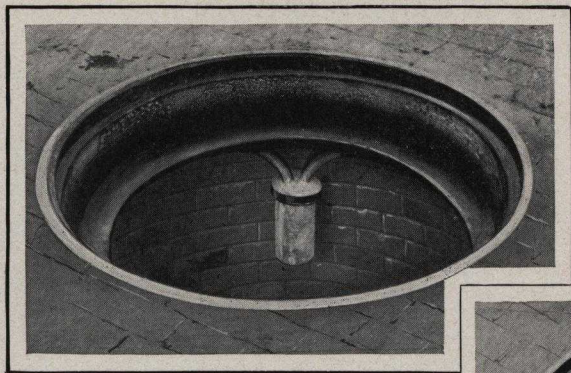
Yours very truly,

(Signed) R. E. THOMPSON,
Vice-Pres't and Gen'l Mgr.

Matthews' Joints are used all over the United States, Canada and Mexico. They are used by the Union of South Africa in Capetown, Algoa Bay, Johannesburg, Pretoria and East London, in South Africa; the Australian Government; the United States Army Signal Corps in the Philippines and Porto Rico; in Jamaica, Prince Edward Island, Cuba, Chile, Argentine Republic, Peru, England and Tasmania.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





Showing use of Matthews Cable Splicing Joints underground.

THE FIRE AND POLICE DEPARTMENTS OF MANY CITIES SWEAR BY THEM

Number 2

DETROIT FIRE DEPARTMENT.
Office of the Superintendent Fire Alarm Telegraph
195 Larned Street, East.

DETROIT, March 7, 1911.

GENTLEMEN:

We have made use of the Matthews' Cable Splicing Joint exclusively for underground work on fire alarm cables, from the time they were first placed on the market, and have never had a case of trouble in one.*

Very truly,
(Signed) LOUIS GASCOIGNE,
Supt. Fire Alarm Telegraph.

Number 3

MADISON FIRE DEPARTMENT.
Central Station. Chas. W. Heyl, Chief.

MADISON, Wis., Jan. 29, 1912.

DEAR SIRs:

In reply to yours of the 22d, will say that we have used your Matthews' Joint in all of our underground work in connection with the Fire Alarm System, and they have given perfect satisfaction in every case; no trouble whatever.

I can certainly recommend them to anyone as a perfect joint, and most anyone can put them on. You may refer all inquiries to me.

Very truly yours,
(Signed) CHAS. W. HEYL,
Chief of Fire Department.

Number 4

FIRE AND POLICE ALARM SYSTEM.
Oscar D. Kleinstaub, Superintendent.

MILWAUKEE, Wis., Jan. 25, 1912.

GENTLEMEN:

Replying to yours of the 22d, will say that we have used the Matthews' Joints for several years and that they are giving perfect satisfaction. We are still using them.

Very truly yours,
(Signed) OSCAR D. KLEINSTEUBER,
Supt. F. & P. A. Systems.

*Have over 750 in use. Started using them in 1905. The Police Department also have over 250 of them in use.

Number 5

DENVER, COLO., Jan. 26, 1912.

GENTLEMEN:

We have several of your Cable Splicing Joints in use on our Fire and Police Telephone and Telegraph System, and are obtaining the best possible results. We are much pleased with them and expect to use them at all our junction points from now on unless we find something better, which I doubt very much.

Very truly yours,
(Signed) DAVID REED,
Supt. Fire Alarm.

Number 6

CITY OF LOUISVILLE FIRE DEPARTMENT.
Office of Chief Engineer.

March 16, 1912.

GENTLEMEN:

Replying to your favor of the 13th inst., while engaged in preparing specifications covering the work incident to the placing of our fire alarm cables in underground conduits, I quite naturally considered the advisability of having them so installed as to obviate the necessity of blowing the joints to effect entrance to the cables when occasion warranted it, as is required in all cases where the ordinary wiped joint is used.

With this end in view, after careful and extensive consideration of the various joints on the market and by reason of the excellent indorsement given Matthews' Cable Splicing Joints by others using them and from personal observation, I concluded to adopt them.

During the time we have had them installed, approximately a year, they have not given us any trouble whatever, nor do I expect any in the future.

Yours truly,
(Signed) C. F. GALL,
Chief Operator.

All of the above gentlemen gave us permission, in February, 1914, to republish their letters.

The Fire or Police Departments in the following cities are using Matthews' Cable Splicing Joints: Brockton, Mass.; Buffalo, Cincinnati; Clinton, Iowa; Columbus, Ohio; Duluth, Erie; Evanston, Ill.; Hastings, Neb.; Indianapolis; Lowell, Mass.; Madison, Wis.; Memphis, Tenn.; Minneapolis; New Bedford, Mass.; Niagara Falls, N. Y.; Oshkosh, Wis.; Peoria, Ill.; Pontiac, Mich.; Portland, Ore.; Portsmouth, Va.; South Bend, Ind.; Springfield, Ohio; Toledo, Ohio; Trenton, N. J.; Utica, N. Y.; Watertown, N. Y.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



IF YOU WANT TO REDUCE YOUR UNDERGROUND CABLE MAINTENANCE COSTS YOU SHOULD USE MATTHEWS CABLE SPLICING JOINTS

Number 7
BEAUMONT TELEPHONE CO.

BEAUMONT, TEX., Jan. 28, 1908.

Replying to yours of the 24th, we will endeavor to get a photograph of the Matthews' Joints in use by us, if possible. Before doing so, however, we wish to advise you that there will be considerable expense incurred in doing this, for the reason that all the joints in use by us are in underground manholes. In at least one of the holes we are positive the joints are covered by water, which stands in the holes at all times, and it would be necessary to pump same out before photos could be obtained. Only one of these joints has been in for a considerable length of time and that gave us some trouble a short time after being installed. As it was installed by a person not experienced, we are of the opinion that the trouble was due to defective installation, as we have had no trouble since with the joint.

It has been the writer's idea to subject these Matthews' Joints to the very hardest possible test before deciding to utilize them to any extent; hence, the installation in the manholes where water would cover them. You can judge of his opinion of the Matthews' Joint by the size of the order recently placed with you, when we state that we are not doing any new work, but are merely preparing to take care of our cable troubles more economically.

Yours very truly,
CHAS. W. EMMER,
Manager.

Number 8
BEAUMONT TELEPHONE CO.

BEAUMONT, TEX., Jan. 21, 1914.

In reply to yours of January 19, 1914, asking if the facts stated in my letter of January 28, 1908, still hold good, we have had no trouble with the joints that have been in service several years, and are satisfied that they will not give trouble for an indefinite period unless disturbed.

Yours truly,
C. W. EMMER,
Manager.

Number 9
MANKATO CITIZENS' TELEPHONE CO.

MANKATO, MINN., Jan. 28, 1914.

Matthews' Cable Splicing Joints are fine. Just the thing for underground work. We like them very much.

P. M. FERGUSON,
Manager.

Number 10
THE WELLSVILLE CO-OPERATIVE TELE. ASSOCIATION.

WELLSVILLE, KAN., Jan. 31, 1914.

In reply to yours of the 21st, will say I have found your Cable Splicing Joints very satisfactory and have adopted them for all our cable work.

JAMES E. MALLORY,
Manager.

Number 11
ENTERPRISE TELEPHONE CO.

PILOT GROVE, MO., Jan. 22, 1914.

Answering yours of the 21st inst., allow me to state that the Matthews' Cable Splicing Joints purchased from you filled the bill perfectly on ditched cable. The cables were brought up out of the ditches and looped through the boxes. The small cable to the left being taken up the pole. In order to wipe the joint on properly the cables were bent over, and after the wiping and beeswax were done it was turned up so that the lower part of the joint box was even with the surface of the ground. We have used no protection or manholes, merely screw it on tight.

H. HARRISON SIMPSON,
Manager.

Number 12
ARCADIA ELEC. LIGHT, ICE & TELE. CO.

ARCADIA, FLA., Jan. 29, 1914.

Replying to yours of Jan. 21st in reference to the Matthews' Cable Splicing Joints bought of you March, 1913. It gives us pleasure to say that these joints have not given us the slightest trouble though they are all underground without the use of manhole or protection of any kind. Our cable is all laid in the sand without other protection than the lead covering.

ARCADIA TELEPHONE CO.,
Ed. Scott, Pres. & Gen. Mgr.

Number 13
CITY ELECTRICAL DEPARTMENT.

TAMPA, FLA., Aug. 15, 1912.

Kindly enter our order, and express as early as is consistent

One Matthews' Telefault,
One dozen No. 2 Matthews' Cable Splicing Joints.

I wish to say that we have eighteen joints now in service in our Fire Alarm and Police Telegraph Systems, and are more than pleased with them, several of them are under water and have been for some weeks and our lines test absolutely clear. I can not say too much for them.

E. D. FITZGERALD,
City Electrician.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.



MATTHEWS TYPES "A" AND "C" TELEFAULT

Patents Pending

The Matthews' Type "C" Telefault is the result of the combined experience of five practical telephone men who have spent years in the telephone field and have had experience with all conditions and kinds of cable trouble. This instrument will locate all cable conductor troubles except "opens." It will locate dead shorts or faults with a very high resistance, and can be used by any lineman who has a fair knowledge of electrical conditions. The noise produced by the interrupted current from the instrument can be picked up by the exploring coil at any distance in the length of a cable. Matthews' Type "C" Telefault is operated on a very low voltage (not over 4 volts), one dry battery being all that is necessary. This does away with the objectionable conditions accompanying high voltage, where other lines would become noisy or there would be a risk of burning out the pairs.

Matthews' Type "A" Telefault has demonstrated its ability to locate all kinds of faults for Independent Telephone Companies; Bell Telephone Companies (90 per cent of these are using it as standard), Postal Telegraph-Cable Company (standard with them), Western Union Telegraph Company, signal departments of many steam railroads, and by the superintendents of fire alarm and police telegraph departments of a large number of municipalities. On pages 117 to 122 you will find a number of letters, which are a few selected from a large number, which tell convincingly the immense value of this instrument to its users.

Matthews' Type "C" Telefault will do all that the Type "A" will do, and much more besides. Furthermore, it is about one-third of the weight of the Type "A," only uses one dry battery, has one-seventh of the voltage. It will be seen that Matthews' Type "C" Telefault will locate high resistance wet spots with comparative ease, and that dead shorts can be located equally as well; these two troubles are the extremes of the requirements for a fault-finding instrument.

It often happens that lightning will enter a cable in spite of the fact that the boxes have the best of protection. The lightning current sometimes travels several hundred feet through the cable and then arcs from one pair to another, or from a pair to the sheath, causing a low resistance cross to ground. In many cases this trouble will be scattered through several pairs located along a considerable length of cable (see letters from Hoosier Telephone Company, Salem, Ind., and Home Telephone Company, of Wabash, Ind., on page 119). With a Wheatstone Bridge and the ordinary Murray or Varley Loop Test this trouble can be located only approximately. The cable then has to be opened and tested both ways. Sometimes it is necessary to open the cable at several places before the faults are found.

W. N. MATTHEWS AND BROTHER, INC. ST. LOUIS U. S. A.



With Matthews' Type "C" Telefault an interrupted current is placed on the line in trouble. The exploring Coil is wired to the terminals of the head telephone, which is worn by the tester. The coil is moved along the cable, and when the fault is reached the noise will suddenly cease, the cable beyond the fault being quiet, while on the side of the fault toward the instrument the noise will be heard.

The noise made by Matthews' Type "C" Telefault sounds like a riveting hammer on a steel girder. It can not be confused with any other tone or hum. This does away with the thermostatic interrupter, which was one of the features of the Type "A" instrument.

Dead shorts have been located with ease in the center of 600-pair cables with the Type "C" Matthews' Telefault and the Type "C" Exploring Coil. This coil will locate faults of all kinds excepting "opens." It is very much more sensitive than the Type "A" Exploring Coil, and therefore it makes possible the use of an extremely low voltage that is not possible with any other kind of coil. Sometimes return currents in the sheath of the cable tend to affect the positive and easy location of grounds. Where this condition exists you should send us an order for a Type "A" Exploring Coil, which is peculiarly adapted for this condition.

The Matthews' Telefaults will pay for themselves many times over in the course of a year in the saving of labor alone. There is also a large saving in the life of the cable, due to the fact that the faults can be located without "cutting in" extra splices or cutting out long lengths of supposedly defective cable. With the old methods of testing, where lightning trouble is frequent, it is not uncommon to see four or five splices within as many spans, where the cable has been opened for the sake of testing and exactly locating the faults. With Matthews' Telefaults the cable is only opened at the exact location of the fault.

HOW TO USE MATTHEWS TYPE "C" TELEFAULT FOR LOCATING METAL PIPES

The terminals are attached to the pipe or other metal object at two accessible points. Suppose that one is trying to find the exact path of a gas or water pipe that is serving a building. One terminal of the instrument should be attached to the pipe at the nearest accessible point to the place where it leaves the building. Then a wire should be attached to the other terminal and carried to the building next door or to the nearest service box (if gas), or fire plug or curb shut-off box (if water), or manhole (if cable or conduit), and attached thereto. When this is done the switch should be thrown on. The exploring coil is then carried in the hand of the operator and the head phone receiver then clamped to his ear. The rapping of the instrument will be distinctly heard as soon as the operator crosses the pipe into the area surrounded by the two service pipes. Then he will find a clearly marked line all around this area where a movement of the exploring coil, only a few inches either way, will pick up or lose the tone entirely. Directly under this line the pipe will be found. If he is tracing the line of a continuous pipe, without any branches, it will be necessary to connect the terminals of Matthews' Type "C" Telefault in two places, one beyond the other. The tone will then be heard on both sides of the pipe between the terminals, but not directly over it. This takes the place of Matthews' Telepipe.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



ASK THOSE THAT USE THEM

CIRCULAR SENT TO 500 USERS IN JANUARY, 1914.

Our records show that on (date) an order was received from you calling for one Matthews' Telefault for shipment to you on ten days' trial. You paid for this instrument so we assume that it has been satisfactory.

Will you write us a letter stating some of the reasons why you kept Matthews' Telefault and paid our trial order bill for it? The enclosed stamped envelope is for your reply.

Possibly you will have no objections to our reproducing your letter for the purpose of influencing others who may be contemplating the purchase of one of these money savers? In any event your reply will be appreciated.

W. N. MATTHEWS & BROTHER.

Number 1

PITTSBURG AND ALLEGHENY TELEPHONE COMPANY.

PITTSBURG, PA., Feb. 2, 1914.

Replying to your kind favor of the 30th ult., in which you desire to know what success we are having with Matthews' Telefault, beg to advise you that the instrument we purchased from you some time ago is very satisfactory.

LOUIS MÜHLHEIZLER,
Chief Engineer.

Number 2

THE DE SOTO TELEPHONE EXCHANGE.

De Soto, Mo., Jan. 30, 1914.

Yours received. Will say that we received the Matthews' Telefault in good order. Have used it in a series of tests, some of which were shorts, good grounds, poor (dry) grounds, low and high resistance wet grounds, and we find that it does the work. In order to get the results men should use their head and follow directions ("closely").

As for ourselves we are satisfied.

C. W. TUCKER,
Supt. of Const.

Number 3

HOPKINS TELEPHONE CO.

HOPKINS, MO., Jan. 26, 1914.

The Matthews' Telefault bought of you in July, 1912, has been very satisfactory to us. We could not afford to be without it.

HOPKINS TELEPHONE CO.

Number 4

THE WESTERN UNION TELEGRAPH COMPANY.

Southern Division.

NASHVILLE, TENN., Feb. 12, 1914.

Your letter of Jan. 30th addressed to Mr. L. H. Beck, Div. Plant Supt., Atlanta, Ga., relative to Matthews' Telefault, was forwarded to me to answer direct, as this district has been using one for the last six years.

In answer to your question as to our reasons for keeping it on a trial order bill, will say that previous to the above improved Matthews' Telefault we had one of your first machines which had given perfect satisfaction. After carefully going over the improvements we did not consider that it was necessary to use the time allowed on trial order.

The machine has on several occasions paid for itself, not only in correctness of test, but its simplicity is such that we can send it out to our linemen, who can use it to locate their trouble. They can locate the trouble within half an inch, and clear it before we could get an expert cableman to make a test. In all my experience I have never seen an expert who could do what the Telefault can.

Last spring we laid a 20-conductor submarine cable across the Mississippi River at Vicksburg, Miss. After it was down about four weeks trouble developed, and we under-run it, using the Telefault, which gave us a perfect location.

We have no objections to your using this letter as you may see fit.

W. K. McCLARIN,
Dist. Plant Supt.

Number 5

THE WESTERN UNION TELEGRAPH COMPANY.

RICHMOND, VA., Feb. 5, 1914.

Answering yours of January 30th: We have had occasion to use the Matthews' Telefault purchased of you in 1910 on numerous occasions and find that it gives satisfactory service for the location of trouble in lead cable.

We did not buy the instrument on trial, for the reason that one had been previously tried out and its services were found satisfactory.

There is no objection to making use of this letter in any way you see fit.

J. B. FAULKNER,
Dist. Plant Supt.

Number 6

THE WESTERN UNION TELEGRAPH COMPANY.

ATLANTA, GA., March 19, 1914.

Referring to your letter of the 16th, relative to Matthews' Telefault, beg to advise we are using your Telefault at the present time.

W. A. NEILL,
Dist. Plant Supt.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



MATTHEWS' TELEFAULT IS USED BY 90 PER CENT OF THE ASSOCIATED BELL COMPANIES

Number 7

BLOOMINGTON TELEPHONE CO.

BLOOMINGTON, NEB., Aug. 4, 1913.

Replying to your letter of July 30, 1913, asking for pieces of faulty cable which was cut out of our cable. I wish to say that we did not cut out any pieces as we located the trouble with your Matthews' Telefault exactly to the inch and the cable opened, trouble cleared and cable sealed up.

ROBT H. MILLER,
President.

Number 8

BOND COUNTY TELEPHONE & TELEGRAPH CO.

GREENVILLE, ILL., Jan. 30, 1914.

Your letter of Jan. 23d, regarding Matthews' Telefault, will say in reply that we have been very successful with your instrument. Haven't made a single failure in locating cable trouble in the two years we have been using the Matthews' Telefault.

G. L. STONE,
Manager.

Number 9

MOUNTAIN HOME TELEPHONE COMPANY.

OGDENSBURG, N. Y., Jan. 26, 1914.

In reply to your letter dated Jan. 24th asking for reasons why we kept the Matthews' Telefault finder on trial order, would say that we have found this Telefault finder very successful. We have found a great many difficult cases of trouble with same, and are still continuing to use same.

We have used this Telefault finder since June last and have had no trouble with same, whatever, excepting to have the misfortune to break one of the vibrators. This was returned to your factory and repaired and returned with little delay.

I take pleasure in recommending this instrument for use as I feel that it is a money saver.

C. G. FOLTS,
Superintendent of Plant.

Number 10

ASHLAND TELEPHONE CO.

ASHLAND, KY., Feb. 6, 1914.

On July 28, 1912, we purchased a Matthews' Telefault on ten days' trial, as we were suspicious of its merits. We have used it with great satisfaction in locating cable trouble, being able to strip the sheath at the very point of trouble in most cases. We never use the bridge on cable trouble now. We should indeed regret to be without your Telefault.

H. B. SMITH,
Gen. Manager.

Number 11

THE WELLSVILLE CO-OPERATIVE TEL. ASSOCIATION.

WELLSVILLE, KAN., Jan. 31, 1914.

In reply to yours of the 30th, will be pleased to tell you why I did not return the Matthews' Telefault sent on trial. It was because I can not get on without it; it is my right-hand man when it comes to cable trouble. At the time I ordered the Telefault I had a wet spot in a fifty-pair cable that I had made several attempts to locate with a bridge, but had failed; but had no trouble locating it with the Telefault.

JAMES E. MALLORY,
Manager.

Number 12

UNITED TELEPHONE COMPANY.

MONROE, WIS., Feb. 2, 1914.

Replying to your letter of January 30th, we certainly kept Matthews' Telefault after giving it even a two days' trial, for we found that while we do not use it often, even two or three times a year pays decidedly well upon the investment. It is not only the financial end which one should look to in clearing trouble promptly, but it is our duty, as a public service corporation, to use every possible means of clearing up trouble promptly, and your instrument is certainly an aid in doing this.

P. J. WEIRICH,
Gen. Manager.

Number 13

FARMERS' MUTUAL TELEPHONE COMPANY.

CLARINDA, IOWA, Jan. 28, 1914.

In reply to your inquiry of January 23d, as to why we paid for the Matthews' Telefault will say that we found it a much needed necessity around a telephone exchange. We can locate our trouble in cable with cheap help, and as a rule clear it without the aid of an experienced cableman. We would not think of trying to run our exchange now without a Telefault unless we could not absolutely get one.

A. J. ADAMS,
Manager.

Number 14

NEW ULM RURAL TELEPHONE CO.

NEW ULM, MINN., Jan. 26, 1914.

In reply to your request of the 24th inst., the Matthews' Telefault that we bought on June 21, 1912, is the best investment that we ever made. We have no trouble in locating shorts, crosses or grounds, and find them to the inch. No money could buy our Telefault if we could not get another.

OTTO R. KOHN,
Manager.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



THE SOUTHERN BELL TEL. & TEL. CO. HAD 81 MATTHEWS TELEFAULTS JUNE 1, 1914

Number 15
THE HOME TELEPHONE CO.

WABASH, IND., Jan. 26, 1914.

The Matthews' Telefault that you shipped us on the 31st day of May, 1913, on approval, we had no opportunity to test until the last week in June, 1913, but we thought well enough of it to remit for it on July 3, 1913, and it is still doing good work for us.

Last July and a part of August we had a series of electrical storms here that made us a lot of trouble, and they also caused us to realize the benefit of your Telefault. It is a great time saver, and it is decidedly more accurate than anything of the kind that we have ever tried.

We thought you would be pleased to know, after this long a time, how we regarded it, and if our statement will be of any benefit to you, you are welcome to use it.

W. S. TRITT,
Secretary.

Number 16
HOOSIER TELEPHONE CO.

SALEM, IND., Jan. 26, 1914.

Your letter of Jan. 23d received and note that you would like to know some of the reasons that we kept the Matthews' Telefault. Our reason is that the time we bought the Telefault we had some very bad cable trouble caused by lightning. They were shorts, grounds, crosses and opens. We found all of them except the opens, and did not miss a case of trouble an inch at any time that we have used the Telefault, which has been many times since June, 1912. Also the machine has saved us time and money, and we could not do without it.

V. E. THURMAN,
Manager.

Number 17
THE RICHMOND HOME TELEPHONE COMPANY.

RICHMOND, IND., Feb. 7, 1914.

In answer to yours of January 30th, inquiring why I kept your Matthews' Telefault sent me on trial, I beg to advise that I kept it for the simple reason of economy of operation.

I do not feel that I am exaggerating a particle when I say that this instrument has saved us ten times its cost in labor and material, to say nothing of the great amount of inconvenience to subscribers.

Since we received your instrument we hardly ever use our galvanometer, only in cases where the trouble is very light. I feel that I am doing an absolute kindness in recommending your Telefault in the highest possible terms to any telephone company that has in use at least a thousand feet of cable in their plant.

I wish you much success, and beg to remain,

W. M. BAILEY,
Gen'l Manager.

Number 18
THE CITY OF TOLEDO.

TOLEDO, OHIO, Sept. 3, 1913.

Regarding my experience with Matthews' Telefault, which I was talking to you about in Watertown, will state that I had very good success in locating underground cable trouble in Dayton during the flood, and it certainly proved very efficient.

Sometime ago a large boat dragging anchor broke one of our heavy water mains crossing the Maumee River, and the water main, being buried, the divers had considerable trouble in locating it, let alone the break.

When the water main was laid, the Western Union Telegraph Company installed a large submarine cable in the same trench; the cable was undisturbed by the boat's anchor, so their service was not interrupted.

To locate the position of the water main in the river we took a few good vacant pairs through the Western Union cable and grounded same on opposite side of the river, connecting the Telefault to pairs and grounded same on water pipe. We then used a long water-proof cord and installed finder in the vapor and water-proof glass receptacle with suitable guard. We had no trouble in picking up the cable by dragging same along the bottom of the river; of course, locating the cable gave us the trench that the water main was laid in.

Thought perhaps this little way of using your Telefault would be interesting to you.

J. T. GREENE,
Superintendent.

Number 19
THE PEOPLE'S TELEPHONE COMPANY.

GENEVA, OHIO, April 16, 1913.

Enclosed find our check, No. 648, for \$34.30, in payment of your invoice of the 14th inst., \$35.00, less 2 per cent.

This invoice covers the purchase of one Matthews' Telefault. We received the instrument yesterday and today put it in use on a case of trouble in a 50-pair cable.

We did not have a single vacant pair in the cable, and six pairs developed a short last week. We were unable to find anything wrong on a close inspection of the sheath of the cable, but when we put the Telefault on it the tone led us to a point just outside the underground. Upon opening the cable at that point we found the six pairs burned together clear in the inner layer of the cable where they could not touch the sheath and cause a ground. We are well pleased with the first test of the instrument, and if future trouble proves as easily located we shall consider the money well spent.

W. R. ELLIS,
Manager.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



THE CENTRAL GROUP OF BELL COMPANIES IN CHICAGO HAD 85 OF THEM JUNE 1, 1914

Number 20
FAIRMOUNT TELEPHONE COMPANY.

FAIRMOUNT, MINN., Aug. 2, 1913.

In reply to yours of the 30th inst., will say that we are more than pleased with the results obtained from the use of the Matthews' Telefault sent us on trial July 15, 1913, and will purchase same because it will do all you claim it will do.

I have used one of the other tone test trouble finders for the past few years, but it did not satisfy me as well as the Matthews' Telefault, which I believe is the only set of its kind. No exchange, large or small, with cable construction, can afford to be without one of your sets at so small a cost.

FRED. A. ROEPKE,
Manager.

Number 21
CUMING COUNTY, IND., TEL. COMPANY.

WISNER, NEB., Jan. 25, 1914.

We received the Matthews' Telefault and used it on the only case of cable trouble we have ever had, and we located the water in an old joint the first test.

We would not part with it as we may need it at any time.

J. W. RICHMOND,
Manager.

Number 22
NORTH STATE TELEPHONE CO.

HIGH POINT, N. C., Jan. 26, 1914.

In regard to the Matthews' Telefault set, we are pleased to say it is giving us excellent satisfaction. We consider it indispensable in an exchange where there is much cable. We also find it useful for supplying suitable A. C. current when testing for opens in cables with bridge set.

J. F. HAYDEN,
Manager.

Number 23
PORTAGE TELEPHONE COMPANY.

PORTAGE, WIS., Feb. 4, 1914.

The ten days' trial of Matthews' Telefault demonstrated that it would pay for itself each year it was in service.

F. H. KUNKEL,
Secretary.

Number 24
CLARKSVILLE HOME TELEPHONE CO.

CLARKSVILLE, TENN., Jan. 31, 1914.

The Matthews' Telefault paid for itself during the ten days' trial, which is the best reason I can give you for keeping same.

D. B. WHITE,
Gen. Manager.

Number 25
MEDINA TELEPHONE COMPANY.

MEDINA, OHIO, Feb. 13, 1914.

Beg to advise we have tried your Telefault in locating crosses, shorts and wet spots, and find it better than anything we have ever used before, and therefore are well suited with it in locating cable trouble.

A. D. AYLAND,
Secretary.

Number 26
WARRENSBURG HOME TELEPHONE COMPANY.

WARRENSBURG, Mo., March 14, 1914.

GENTLEMEN:

Referring to your letter of recent date as to why we paid for the Matthews' Telefault, we use it for locating heavy shorts and grounds with success, and in some cases it has been a help to us in locating wet spots in cable, where the insulation is very low. Its advantage over the set we had been using, of our own manufacture, its compactness and the requirement of only four cells of battery instead of twenty-five or thirty, as was necessary with our other apparatus.

Very truly yours,

By H. C. HOUSTON,
Gen. Supt.

Number 27
THE HILLSBORO TELEPHONE CO.

HILLSBORO, TEX., April 22, 1914.

GENTLEMEN:

On September 13th last we ordered on ten days' trial one Matthews' Telefault in which we had little confidence before trying out.

Immediately after receiving the Telefault we had continued rains which caused considerable trouble on some crystallized cable, which, as you know, is usually difficult to locate, as it will break enough to admit moisture and still be invisible to the eye.

We put the Telefault in use and by the expiration of the ten days' trial the instrument had more than paid for itself, and have used it continually since with wonderful success.

Yours truly,

O. G. FREEMAN,
Manager.

OGF/MG.

Some of the railroads that use Matthews' Telefault are mentioned below:

A. T. & S. F. R. R. Co.; Delaware & Hudson R. R. Co.; D. L. & W. R. R. Co.; Erie R. R. Co.; Illinois Central R. R. Co.; N. Y. C. & H. R. R. Co.; L. & N. R. R. Co.; N. Y., N. H. & H. R. R. Co.; Great Northern R. R. Co.; Chicago Great Western R. R. Co.; Central R. R. of N. J., etc.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



OVER TWELVE HUNDRED MATTHEWS' TELEFAULTS WERE IN USE JUNE 1, 1914

Number 28
THE BREVARD COUNTY TELEPHONE CO.

INDIANOLA, FLA., March 29, 1913.

DEAR SIR:

Replying to yours of the 22d ult., will state:

We are using an ordinary 15-pair lead encased aerial cable for crossing the Indian River at Cocoa, Fla., to Merritts Island, a distance of 7,750 feet. This cable was laid on the river bottom, which is of sand, and we have had no trouble of any kind except from sharks and sawfish, which evidently take the cable for eels, biting and striking it, causing various sizes of punctures, generally small. We have had some twenty odd punctures from this cause, and in nearly all cases the teeth just going through the lead case.

It was rather a difficult matter to locate these punctures with the ordinary cable testers, on account of the various amounts of moisture and the difficulty of knowing just how many feet from the shore you are, even if you have an accurate measurement of how far from the end of cable the puncture is, and often the puncture is so small it is hard to see or find with the eye.

We purchased a Matthews' Telefault and must say it has given the very best of satisfaction. No matter how large or small a puncture, it will readily locate the moisture, show amount of cable that is wet, giving us an idea whether it is necessary to splice it in a section or if it can be dried without cutting. If we dry it, it will also show when it is dried.

We find it unsatisfactory to attempt to dry out more than six inches of water, so you can readily see what a great advantage it is to know how much of the cable is wet.

On account of the rapidity of locating wet spots with this tester, we seldom have to splice in a section as in some cases we locate the moisture, dry it out and return to river bed three hours after puncture.

If the above will be of any interest to you, you are at liberty to use it to the best of advantage, as I appreciate the fact that the more these testers are used the better for the telephone business.

Yours truly,

A. A. BUCK,
General Manager.

Number 29
THE DALHART TELEPHONE COMPANY.

DALHART, TEX., Jan. 26, 1914.

Replying to your inquiry of the 23d inst., on December 5, 1911, we purchased a Matthews' Telefault, since that time we have had occasion to use it in numerous cases of cable trouble and have found it reliable in each instance, quickly and surely locating the exact spot where trouble is located.

We would not care to part with the Telefault, and recommend it to anyone using cable.

D. O. HAZLETON,
Gen. Manager.

THE POSTAL TELEGRAPH CABLE CO. HAVE ADOPTED MATTHEWS' TELEFAULT AS THEIR STANDARD.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

Number 30
GONZALES TELEPHONE COMPANY.

GONZALES, TEX., Jan. 27, 1914.

We have had excellent success with the Matthews' Telefault we purchased of you on May 27, 1913.

The more experience we have in using it, the better we like it; in fact, the better and easier we are able to locate trouble with it.

J. W. VERNOR,
Manager.

Number 31
CHRISTIAN-TODD TELEPHONE COMPANY.

HOPKINSVILLE, KY., April 25, 1913.

Answering yours of the 23d, in regard to the Matthews' Telefault: This instrument certainly does accomplish all that is claimed for it. I have been using a tone test and exploring coil for several years in locating crosses between conductors and between conductors and cable armor, but have experienced a great deal of trouble in locating wet spots.

A few days ago your representative called on me just at a time when I was troubled with a damp cable. I explained to him that the conductors were not sufficiently crossed for me to locate the trouble with the apparatus I was using. He kindly agreed to lend me his sample. The trouble was located exactly in a very short time, much to my surprise, on account of the cable only being slightly damp. I am now using the Matthews' Telefault in my cable department.

Many thanks for your Catalogue No. 8.

W. J. TOMERLIN,
Plant Chief.

HOPKINSVILLE, KY., June 5, 1913.

Answering yours of June 2d, in regard to my letter of April 25th: I received your letter requesting permission to use my letter. Before replying I desired to give your instrument a thorough tryout. It has stood the test O. K., and you are at liberty to use my letter if you so desire.

Wishing you the success you deserve, I am,
W. J. TOMERLIN,
Plant Chief.

Number 32
THE CAMPBELLVILLE TELEPHONE CO.

CAMPBELLVILLE, KY., Jan. 28, 1914.

On August 6, 1913, we purchased one of your Matthews' "Tell-a-faults" (that's the correct name), and with inexperienced hands located cable trouble enough the next day to justify the outlay. The longer one is used the more it is appreciated.

G. V. MURRAY,
President.



A FEW SHORT-CUT SUGGESTIONS TO USERS OF MATTHEWS TELEFAULTS

By O. F. Tallman

Reprinted from *Telephony* of April 11, 1914.

"AN ABSOLUTE NECESSITY!" is the verdict of those who have seen the Matthews' Telefault in action and have realized the time and expense it saves in locating faults in cable, as compared to the old methods. Below are a few suggestions, which, if followed, will simplify the location of cable trouble. We will take the various classes of trouble up separately.

What is termed "A SHORT," is actually a cross on the pairs in trouble between the odd and even wire or tip and ring. Where it has been determined that this is the case, a wire should be run from one of the binding posts of the Telefault Instrument to the odd wire of the pair in trouble and another from the remaining binding post to the even wire. This forms a complete circuit from the Telefault Instrument over the odd wire of cable pairs to the *short to be located* and back over the even wire to the Telefault Instrument. This creates a zone or field limited to the circuit over which the tone generated by the Telefault Instrument travels when switches are closed and the vibrator starts.

The Telefault Exploring Coil is so constructed that when it is brought within the above mentioned field or zone it picks up by induction and transmits to the receiver the tone generated by the Telefault Instrument. This coil is connected in series with the receiver. Before leaving the Telefault Instrument it is advisable to make a test with the Telefault Exploring Coil to familiarize yourself with the volume of tone which may be expected when looking for the trouble on the cable.

Another test that should be made before leaving the Telefault Instrument is as follows: With the Telefault Exploring Coil held between the two wires leading from the Telefault Instrument to the pair in trouble, listen carefully and determine if you can notice any difference in the volume of tone when you put a "short" temporarily at the point where the lead wires from the Telefault Instrument are connected to the pair in trouble. This will give you an approximate idea of the distance from the Telefault Instrument at which to expect to find the trouble. The higher the resistance the weaker will be the volume of tone. In making this test be sure that you are not picking up the tone from the Telefault Instrument directly, but from the zone between the pair of wires connecting the Telefault Instrument to the pair of wires in trouble. If you make this preliminary test on each case of trouble it will not be long before you will be able to estimate very closely the location of the trouble. This will, of course, save much time and unnecessary climbing of poles. You can readily appreciate that experience will increase one's accuracy in judging distance by this means.

After making the above approximate location I would advise that a test be made about every fifth pole, until the trouble is located within a distance of five poles. Then divide the distance and make a test on the center pole of the five; then the three and you will have the trouble within one span. I am, of course, assuming that the trouble has not been located on previous tests. If you have not located the trouble in any of these pole-climbing tests, then it will be necessary to ride the messenger in a strand chair in order to obtain an exact location of the trouble.

It will be found that, so long as the troubleman is between the Telefault Instrument and the trouble, the tone will be heard through the Telefault Exploring Coil and Receiver, but beyond the point of the trouble no tone will be heard. The point where the tone ceases is the point where the trouble is located.

"A CROSS" is made when the even or odd conductor becomes crossed with some adjoining wire or wires. In attempting to locate "A Cross" the same method should be followed as that given above for locating "A Short," i. e., the two wires from the Telefault Instrument are connected in series with the two crossed conductors in the cable. It will be found on making comparative tests that "A Cross" is more



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

easily located than a "Short." This is because of the fact that the volume of tone is much stronger for a "Cross" than it is for a "Short," due to the construction of the cable. The conductors of a pair lie much closer together and are also transposed more frequently, thereby causing the tone to be cut down considerably. It will also be noticed that the nearer the conductors in trouble are to the lead sheath of the cable the more distinct will be the tone. This is the case in all cable trouble.

"A GROUND" is made when one or more of the conductors come in contact with the cable sheath. For locating purposes this is the only definition of "A Ground" which should be considered. When a conductor becomes crossed with the grounded side of another line, it is reported to the troubleman as "a grounded line," but is actually "A Cross" and should be so considered for locating purposes. This has been the greatest stumbling block to users of Matthews' Telefault and those who do not know better usually blame the instrument for their own lack of knowledge on this point, which is unfair.

The troubleman should make a check test to determine whether or not the "ground" reported to him is actually a "Sheathing Ground" or a "Cross to Ground." If the latter, it should be treated as "A Cross" and not as "A Ground." To determine whether or not you have a true "Ground" to find, use the Telefault Instrument as a tone test set; *i. e.*, ground one side through a condenser and connect the other side to the wire in trouble. (This connection should be made at a place where all of the pairs of the cable in trouble are accessible. This might be at the main frame or at a distributing box on the line or where the cable has been cut open.) If an actual "sheathing ground" is determined, connect the Telefault Instrument in series to the conductor in trouble and the sheath of the *same cable* and it will be found that there will be no trouble in making the location. If it is other than a "sheathing ground" you will get a false location. Now, with one side of the receiver grounded, run over the cable carefully and determine whether it is crossed with some other conductor. If this happens to be the case the tone will come up very strong in the receiver when the crossed pair is reached. If the trouble proves to be "A Cross" locate it as such; but if no "Cross" is found and you are sure the conductor is not in trouble outside of the cable, you will be safe in assuming that the trouble is a cable or a "Sheathing Ground."

If you have an actual "Sheathing Ground" connect the Telefault Instrument in series to the conductor in trouble and the sheath of the same cable. If this is done, you will have no trouble in making the location.

"WET TROUBLE."—When it has been determined that the cable is wet, the best method of testing is to choose from six to ten pairs (those of the lowest resistance) and connect an equal number to each binding post of the Telefault Instrument. Then proceed to locate the trouble as you would in attempting to find "A Cross." *Be very careful to see that no pair included in the bunch you have selected has an old trouble;* that is likely to confuse you when hunting for the "Wet Trouble."

For example: Pair forty-seven might be an old "ground" which has been discarded in the past and replaced by a spare pair. The man who did this probably intended to clear up the trouble at some future date, but neglected to do so and no record was kept of the matter. You might think that because this pair shows a very low resistance that it will be an excellent pair to use as an aid to locating the "wet spot." The very fact that it does show a very much lower resistance than other pairs in the same cable should be a warning signal for you to be very sure before accepting it; otherwise it will cause a false location. The safest thing to do is to select eight or ten lines which are known to be working lines and free from trouble and disconnect all other outside lines. (See article on pages 134 and 135.)

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



MATTHEWS TELEFAULT No.

Patent No. 925594
Other Patents Pending

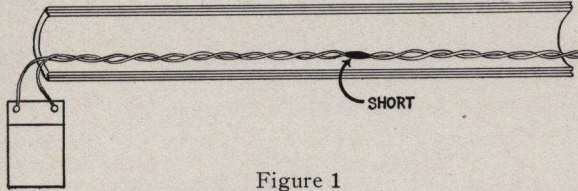


Figure 1
Shows connection for short circuit.

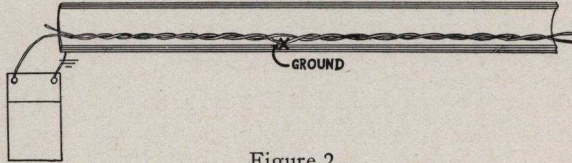


Figure 2
Shows connection for low resistance or solid "Grounds"

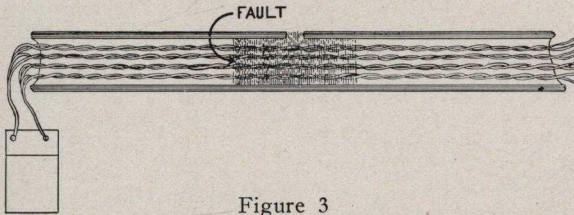


Figure 3
Best method of locating bad wet spot

Some of the more common connections are shown in the diagrams. If anything about this instrument becomes inoperative, it will usually be cheaper to send it back to us for repair rather than try to do it yourself.

The above, on a piece of cardboard, is tacked in the lid of each Type C Matthews' Telefault.

It should be rarely necessary to take this instrument out on the line. It should be put in charge of the wire chief. He can connect it to the line or lines in trouble, and he can see that it operates satisfactorily without interfering with his regular duties.

All that the man out on the line needs is the exploring coil and receiver. Once in a long time it may be advisable to take the whole instrument out on the line but not often.

Before attempting to operate this instrument read the book of directions carefully. It will be time well spent if those who expect to operate this instrument will get a piece of scrap cable about 50 feet long and practice with it in the location of artificial faults.

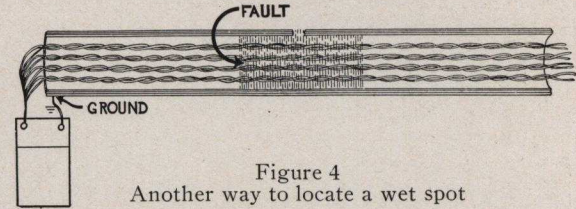


Figure 4
Another way to locate a wet spot

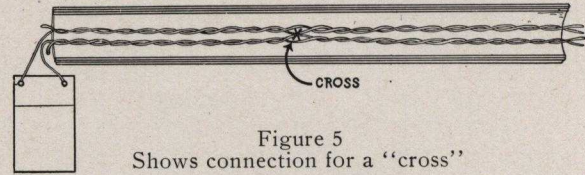
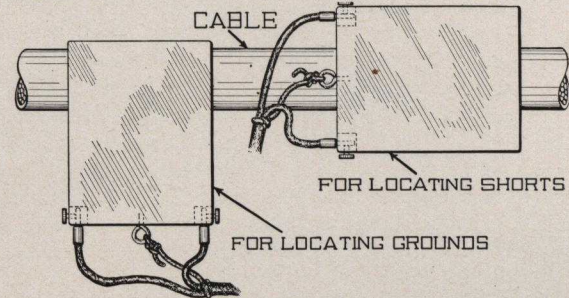


Figure 5
Shows connection for a "cross"



CORRECT POSITION OF COIL ON CABLE
Figure 6



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

TROUBLE—ITS CAUSES AND METHOD OF LOCATION*

By John L. Fay

"Corona" appeared on the switchboard structure at Page Avenue Substation. Mr. Walter Millan drew Mr. Yandell's attention to the matter, and the latter immediately made an investigation. Mr. Yandell directed that No. 899 and No. 895, 13,200 volts 60-cvclce cable, be taken out of service, one at a time and tested for voltage to ground for the reason that "Corona" indicated over-stressed insulation.

No. 895 was taken out of service, but the "Corona" was still in evidence. No. 895 was put back in service and No. 899 taken out of service. The "Corona" disturbance disappeared.

No. 899 was then livened up at one end and a voltage test made to ground which indicated that the "A" phase of No. 899 had a high resistance ground.

At 12:15 p. m. Mr. Yandell reported this state of affairs to Mr. Eales, chief engineer of the Electrical Department, who immediately gave orders to clear up the situation.

At 12:20 p. m.—Trouble reported to the Underground Department. At 12:20 p. m.—Messrs. J. M. Jackson, Chas. Watts and Paul Jeude left 12th and Locust with the Telefault in a Ford car. At 12:30 p. m.—Arrived at Ashley St. At 12:30 p. m.—Requested feeder taken out of service. At 12:59 p. m.—Feeder taken out of service. At 1:02 p. m.—Telefault working. At 1:05 p. m.—First test south end basement. At 1:10 p. m.—Left Lewis Street Station. At 1:15 p. m.—Test, 3d and Biddle. At 1:22 p. m.—Test, 2800 Franklin. At 1:30 p. m.—Test, Walton and all south of Delmar. At 1:36 p. m.—Test, Clara and Delmar. At 1:42 p. m.—Test, Hamilton and Horton. This test indicated they were beyond the point of trouble. Recheck tests made at: At 1:50 p. m. Hamilton and Delmar. At 1:52 p. m.—Hamilton and Suburban tracks. At 1:54 p. m.—Hamilton and Maple. At 1:58 p. m.—Trouble located and reported. At 2:10 p. m.—Cable sawed in two by Mr. Jackson at Hamilton and Horton. At 2:20 p. m.—Cable sawed in two at Hamilton and Maple. At 2:30 p. m.—Rechecked with 500 volts D. C. current from Lewis Street Station, and ground located definitely. At 2:40 p. m.—Jas. Randall, Mack Randall and Chas. Ligible, on Auto No. 38, left 14th and Franklin, picked up supplies en route. Arrived at 4:10 p. m. At 3:35 p. m.—Mr. Wm. Burggraf, foreman of cable gang, on No. 9 auto truck, notified by Mr. McKee at Broadway and Arsenal, with instructions to change batteries at Station "B" en route. Arrived on job, Hamilton and Maple, 6:20 p. m. At 6:10 p. m.—W. T. Scrafton and cable wagon left Gratiot Street Warehouse. Arrived on job, 8:35 p. m. At 7:45 p. m.—Mr. Burggraf and gang removed cable. At 9:20 p. m.—Mr. Burggraf and gang drew in new cable. At 9:30 p. m.—Mr. Jackson grounded "A" phase of No. 899 cable for test at Page Avenue Substation, for splicers test in jointing. At 9:45 p. m.—Messrs. Mack Randall and Tom Pounds, splicers, set phases of conductors between Page Avenue Substation and Lewis Street Station preparatory to making splices. At 11:00 p. m.—Messrs. Murdock, Jackson and Millan checked phases between Page Avenue Substation and Lewis Street Station. At 12:20 a. m.—No. 899 feeder O. K'd. to Mr. Murdock, completely repaired, ready to put in service. At 12:30 a. m.—No. 899 put in service by Mr. Murdock. Took load O. K. ready to put in service. At 2:20 a. m.—All gangs on way home. Mr. Burggraf with No. 9 auto arrived at Gratiot Street Warehouse.

Distance from Ashley St. to point of trouble located, 38,233 feet.

Cable: 4/0-3 cond. 7/32 varnished cambric insulation, lead sheath 1/8-inch in thickness.

Primary Cause of Trouble.—Conduit stopped up by concrete in the construction of the subway.

Secondary Cause of Trouble.—Men working under Mr. Burggraf excavating at a point 8 feet south of the manhole, at the N. W. corner of Horton and Hamilton, damaged the lead sheath of No. 899 cable.

Work done under conduit permit No. 13,944; excavation permit No. 90,926.

The damage to the lead sheath permitted the moisture to be gradually absorbed by the insulation until it reached the breaking-down point. The photograph shows the damaged piece of cable and the instrument and special exploring coil which made possible the rapid location of this trouble.

Instrument.—This device consists of a generator of high frequency, low current value, a specially designed exploring coil, and an attached telephone receiver. The sending instrument consists of a battery of four dry cells, a non-inductive resistance, an unbalanced coil, an interrupter and a condenser. (Matthews Type B Telefault.)

The four dry cells are connected in series, one end connected to a terminal post which may be connected directly to the wire in the cable in trouble. From the other battery terminal a connection is conducted through the unbalanced coil and the non-inductive resistance, and this

*Taken by permission from "Union Electric Bulletin" of June, 1914. Published by Union Electric Light and Power Co., St. Louis.

connection is connected to the lead sheath of the cable. A tap taken off at a predetermined point in the unbalanced coil is connected in multiple across the unbalanced coil, the battery, the interrupter, and the buzzer, which creates the pulsating high-frequency current in the cable under test.

The particular improvement in the apparatus lies in the design of the exploring coil, to which is attached a telephone receiver. These two devices form the portable part of the set carried by the troubleman tracing the trouble.

The exploring coil consists of two laminated cores, built up of non-aging steel plates, each core being insulated from the other by means of a fibre block performing the dual function of separating the magnetic cores and acting as a head board for the connections.

Three separate and distinct windings are placed on each core. The first or bottom coils on the magnetic cores are connected in series with the open ends brought out to a terminal or fibre block. At a predetermined point the second coil is connected to the winding of the bottom coil, is wound in parallel with it, and has its free ends brought out to a short-circuiting device on the fibre head board. The third coil, a differential winding, has its length so proportioned that its resistance is intermediate between the first and second coil. Its free ends are connected on the head board so that its magnetic field will oppose the fields of the first and second coils.

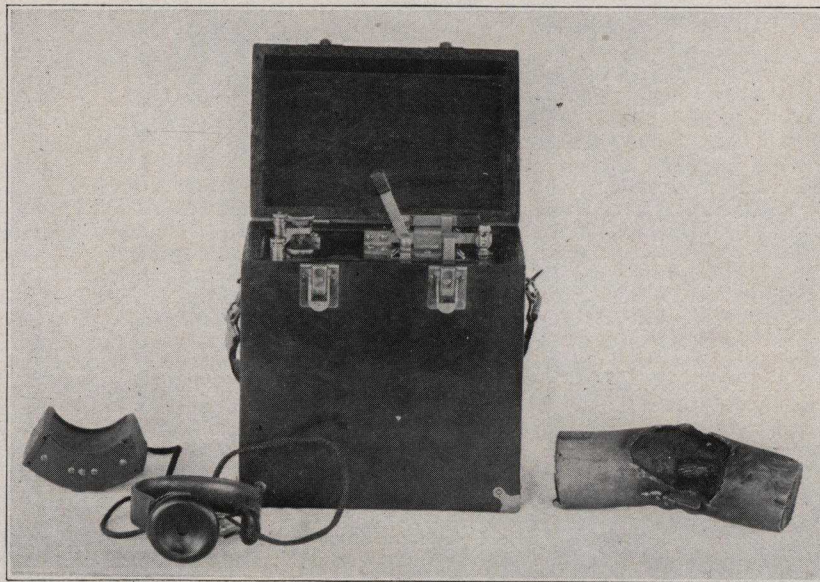
As will be noted from the accompanying illustration, the windings of the exploring coil are so arranged as to form an arc of a circle about the conductor under test. Thus, in locating a case of trouble after the testing set generator has been connected to the defective cable, troublemen have to open manholes and apply the exploring coil to the cable in question. The presence of inductive noise in the receiver will then inform the troubleman whether he is beyond the trouble or not.

If the exploring coil picks up the pulsating inductive noise, the troubleman at once knows that the fault is not between him and the station at which the sending instrument is in operation and continues on away from the sending station until there is no inductive noise apparent in the cable. He then knows he is beyond the trouble and returns back until he picks up the inductive noise on the cable again and just at the point where he is unable to find any inductive noise; it is then known the defect in the cable is between the manhole where he could hear inductive noise and the manhole where he could not hear inductive noise in the cable.

In the exploring coil is a combination of connections to terminals, and the pressing of a button which controls the short-circuiting device on the exploring coil changes the tone of the instrument and eliminates the possibility of the troubleman being led astray because of the presence of sneak currents or inductive tones produced by adjacent cables carrying heavy currents of different frequencies.

The use of this instrument eliminates the old and more expensive method of cutting the cable at frequent intervals in order to locate the fault. It is quicker and more economical than the Wheatstone-bridge method.

Mr. Jackson and Mr. Randall say that by the old method they would have had to cut the cables nine times to locate this cable trouble; whereas, by the method employed, the cable was cut only at the points where it would be cut to withdraw and draw in a new cable.



Inductive Testing Set

SERVICE IN LOCATING TROUBLE *

By L. H. Gamp

St. Louis' slogan is "To the Front."

The Union Electric Light and Power Company has used this in coming to the front with an instrument that will quickly locate cable trouble and thus keep its own code word "Service" to its present high standard.

On the night of October 4th about 11:49 p. m. the operator at Substation No. 1 reported a ground on the tie line feeder between Substation No. 1 and Substation No. 3 on the low D. C. system, and shortly after the operator at Substation No. 4 reported another ground on the tie line feeder between Substation No. 4 and Substation No. 3. Ordinarily the Trouble Department, when they receive such a call, notify the Underground Department and they patrol the line, which means the inspection of manholes for signs of trouble, and if they find nothing in the manholes that looks like trouble the only way left is to cut cables and test sections. It takes some time to get the Underground Department from their homes to the scene of trouble, but when they are ready there is quite a bit of work to be done before the trouble can be located.

The procedure in locating cable trouble is very lengthy and expensive. The first thing to be done is to cut the cable in the center and test to find which half is defective. The defective half is then cut in two and its defective half found by testing, and so on until the trouble is found to lie between two manholes (manholes are usually at street intersections). When the trouble is located in one block it is then necessary to pull the cable out and either repair or replace with new cable. The cost of this manner of locating trouble is very great, as each of the cuts in a cable cost approximately \$15.00, and is also a very slow and tedious operation and would keep the cable out of commission for many hours in addition to the expense of extra joints to be made in false cuts.

When the trouble was reported by substation operators giving the feeder numbers, Mr. Hendrix, trouble foreman on watch, and Mr. Scullin, referred to the service records and proceeded to locate the trouble by using an instrument (Type B Matthews' Telefault) in combination with a specially designed coil, designed by the superintendent of distribution (John L. Fay), which locates trouble by producing a tone in the cable similar to the tone used when getting the "busy" signal on a telephone. All that needs to be done is to attach the instrument to the cable which is defective, at the station; carry headpiece and slide coil along the cable in different manholes and if the tone is still heard the operator knows the trouble is still ahead of him. A distance of two feet beyond the trouble no tone will be received, and thus the trouble can be located to almost an inch where cable is defective. The operation is much quicker and more simple than cutting and testing and does not cost anything to repair false cuts.

In the first case cited the trouble was located in twenty-five minutes after ground was reported and the Underground Department went straight to manhole where cable was defective and repaired it while the Trouble Department was locating the trouble on the second cable, after which the Underground Department repaired it. Both tie lines were placed in service early on the morning of the fifth.

In this case the instrument saved something like \$50.00 in labor and material, put the lines in operation some twenty-four hours before the old method would have done so, thus saving three plants from running when one was all that was necessary, and lastly our code word "Service" from being tarnished.

*Taken from *Union Electric Bulletin*, November, 1913, issue. Published by the Union Electric Light and Power Co. of St. Louis.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



READ THE TESTIMONY OF TWO PROMINENT CENTRAL STATIONS CONCERNING THE TYPE B MATTHEWS TELEFAULT

CLIFF ELECTRICAL DISTRIBUTING CO.

NIAGARA FALLS, N. Y., June 9, 1914.

W. N. MATTHEWS AND BRO.,
3722 Forest Park Blvd., St. Louis, Mo.

Gentlemen—Referring to your valued favor of June 4th in regard to Matthews Type "B" Telefault, would advise that we purchased this piece of apparatus in order to insure our workmen against the danger of cutting into live cables, as we use it to determine a dead cable among a number of live ones.

We also use this apparatus for locating faults in cables that are defective, and we have found it a very useful piece of apparatus.

Yours very truly,

CLIFF ELEC'L DIST. CO.

John L. Harper,
Chief Engineer.

JLH:B

DUQUESNE LIGHT COMPANY

PITTSBURGH, PA., Jan. 31, 1914.

W. N. MATTHEWS AND BRO.,
3722 Forest Park Blvd., St. Louis, Mo.

Gentlemen—In reply to your inquiry of January 23d, relative to the Matthews Telefault, Type "B," which we ordered from you March 1, 1912, wish to advise that our Superintendent of the Underground Department states that this instrument has paid for itself a hundred times over and would not part with it for any consideration if unable to obtain another. Would advise that we are now considering ordering three of such instruments.

Yours truly,

H. N. MÜLLER,
Supt. of Distribution.

WFH:R

By W. F. HESS.

P. S. It never failed to locate the trouble.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.





FIGURE 1

Showing Man Finding The Length of Pole necessary to Clear Trees 5 Feet with Teleheight



FIGURE 2

Detail View Showing Proper Method of Using Matthews Teleheight



FIGURE 3

Looking to See What Length of Pole is Indicated on Scale by Pointer on Teleheight



FIGURE 4

Writing Down Length of Pole in Note Book

USES FOR MATTHEWS TELEHEIGHTS

For giving the exact length of poles that should be used to afford standard clearances over wires of other companies, shade trees, buildings and other obstructions. Type A for N. E. L. A. specifications and Type B for A. T. & T. Co. specifications. Range 20 to 75 feet.

For the use of light, power, telephone and telegraph companies, for giving the exact height in feet of any object above the ground. Type C. Range 20 to 75 feet.

The Type C Matthews' Teleheight has been sold for the following purposes: To railroad companies so that their inspectors can quickly, easily and safely determine whether wires, bridges, "ticklers," etc., have the proper clearance. (See newspaper clipping below.) To billboard companies so that their inspectors can quickly determine the height of billboards erected by local contractors and thus determine whether they are getting the number of square feet of space for which they contracted. To the American Tobacco Company for the same purpose, to check up the billboard companies. To foresters to measure the height of trees. To steamboat companies on the Mississippi River so that they can determine whether they have enough clearance for their stacks to pass under bridges at different stages of the river. To a man who took it to Europe with him so that he could see how high various things were on the other side. No doubt many more uses for this valuable instrument will occur to those who read about it.

SAFETY-FIRST WARNINGS

A lineman threw a steel tape measure over a high tension line in order to measure its height. He was badly burned. If he had had a Type C Matthews' Teleheight this accident would have been prevented. This happened in New Hampshire not so very long ago.

Furnish them to hook and ladder wagons of fire departments, so that they will know how high buildings and windows therein are, so that they can get out a ladder of proper length. Saves time. Time at a fire means lives saved. Read newspaper clipping below:

LIVE WIRE SINGED HIS HAIR

PENNSYLVANIA TRAINMAN IN GREAT GOOD LUCK HE WAS NOT HALF-INCH TALLER

Glenside, Pa.—All the hair on top of the head of William Tennent, a trainman on the Trenton Cut-off Railroad, was singed off when his head was grazed by an electric wire charged with 2,300 volts. The accident happened while Tennent was standing on top of a boxcar of his train as it passed beneath a bridge at Corson's station.

As the wire grazed his head Tennent was hurled flat on the top of the car, partly conscious. He fell parallel with the car, but not to the ground, and when the train reached Whitmarsh station other trainmen were sent back to investigate. They found that heavily charged wires of an electric company passing under the bridge bed had sagged at least three feet, and that the gases and soot from engines had eaten away the insulation.

Tennent's head, as he stood on the boxcar, was "flush" with the sagging wires, and if he had been a half-inch taller, or if the wires had sagged half an inch more, he would have received the full force of 2,300 volts and been instantly electrocuted.

The trial proposition on page 5, that applies to all of these instruments, is exceedingly liberal and enables any one to determine their value before having to spend a cent for them.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



THE EXPERT GUESSER

When one of your men—a good guesser—is sent out to make up an estimate for a pole line that must run through a line of shade trees, he should be given one of the Matthews' Teleheights, described on pages 28, 29, 129 and 130. Either the Type A, B or C. And in spite of the fact that he is an "expert" at guessing, with this inexpensive, simple, non-mathematical instrument he can save his company much time and money.

A shade tree is irregular in its shape. No two are alike and no man, no matter how good a guesser, can help but make a mistake in estimating the heights of protruding limbs that may interfere with the wires.

What too frequently happens is that one or two or maybe more heights have been "guessed short." What happens? The poles are sent out according to the estimate; the holes are dug for them; after much labor the pole is lifted and dropped into the hole. Then, lo and behold! it is too short to give the proper clearance over the limbs. Anxious to save their company the money represented by the labor expended up to this point, someone suggests that they "trim" the shade trees. This is done and the sequel is too frequently similar to the clippings below, taken from the March 21, 1914, issue of *Telephony*, and the December 27, 1913, issue of the *Electrical World*. An agitation for making the "Ruthless Public Service Corporation" to put their wires underground may follow such mistakes.

DAMAGE TO SHADE TREES

Suit was brought against the Citizens Telephone Co. of Muskegon, Mich., for damages alleged to be wrongfully done by it to certain shade trees belonging to one Hoben, along the highway: The telephone company defended on the ground that it was not sued by its proper corporate name, which is "Citizens Telephone Company of Muskegon, Michigan." The Supreme Court refused to reverse a judgment against the telephone company on this ground, but did reverse the judgment, because it did not appear that service was made on an authorized agent of the telephone company. *Hoben vs. Citizens Telephone Co.*, 142 Northwestern, 1070.

INTERFERING WITH SHADE TREES

Although a city of North Carolina, for the purpose of its government and management may, in its discretion, cut down and trim trees bordering on streets, it can not transfer its right of control over shade trees to an individual or quasi-public corporation, such as an electric light company, which is authorized to use the streets. Such a company can not invade the right of a property owner as to the trees in front of his property without paying compensation therefor. Where an electric light company invades such rights with wantonness, oppression or bad motive, the abutting owner may be awarded pecuniary damages. The damages recovered may be for the destruction of the trees, although the trimming was done in a skillful manner. So held the Supreme Court of North Carolina in an action brought against an electric light company in the city of Raleigh, for injury to shade trees standing along the sidewalk in the street. *Moore vs. Carolina Power & Light Co.*, 79 Southeastern, 596.

ELECTRIC COMPANY LIABLE FOR DAMAGES TO SHADE TREES

Inasmuch as electric light companies do a great deal of tree trimming at this time of the year, the case recently decided by the Supreme Court of North Carolina (*Moore vs. Carolina Power & Light Company*, 79 S. E. Rep., 596) is of interest. The plaintiffs were abutting owners of property on a city street. The electric light company, for the purpose of facilitating the use and operation of its lines and poles, trimmed certain shade trees bordering on the street in front of plaintiff's property. Suit was brought for damages alleging depreciation of plaintiff's property because of the impairment of its use and enjoyment resulting from the above depredation. The defense was interposed that as the fee in the streets belonged to the State, and as defendant company was a quasi-public corporation, plaintiffs had no rights against the company that could interfere with any impairment of the trees for its convenience. The Supreme Court of North Carolina, however, while holding that a municipal corporation which enjoys the possession of its streets has absolute control over bordering trees, provided that no oppression is exercised impairing the rights of abutting owners in their easements in the shade of the trees, yet decided that this municipal power of control was not delegable and could not be conferred upon even a quasi-public corporation, with the result that defendant company was required to be responsible for any damages resulting.

THE STORY OF MATTHEWS HOLDFAST LAMP GUARDS IS PICTURED ON THIS PAGE AND THE NEXT



Matthews Holdfast Lamp Guards will absolutely eliminate lamp breakage.



LIGHT BULB FIRES AUTOS

Alderman Rossbach's Two \$11,400 Cars Destroyed by Flames.

Alderman Victor A. Rossbach's garage at 1220 Ridge Ave., two automobiles and a lot of furniture were destroyed by fire last night, while the chauffeur, Gustave Johnson, had a narrow escape. Johnson was at work under one of the machines when the electric light he held in his hand dropped to the stone floor and the bulb exploded, setting fire to some waste. He had just time enough to roll from beneath the car when the flames shot to the gasoline tank. The fire was so rapid that by the time the fire engines arrived the garage had been destroyed. The loss is estimated at \$11,400.

From Chicago Examiner, Nov. 16, 1912

A Matthews Holdfast Lamp Guard would have prevented this

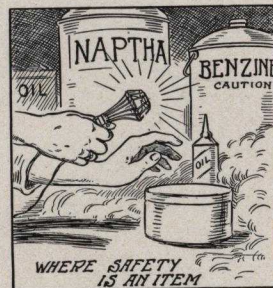
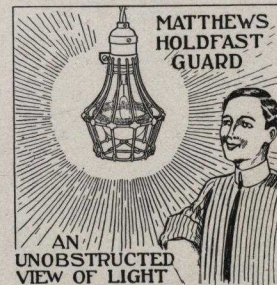
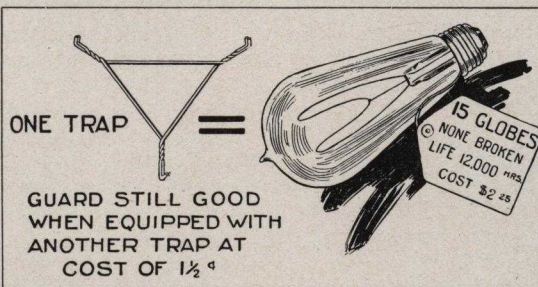
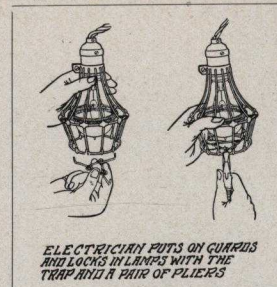
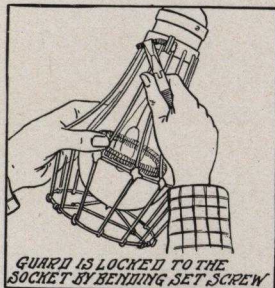


Matthews Holdfast Lamp Guards are the best preventive of lamp stealing.



This is because they lock permanently to the lamp socket. Write for details.

Matthews Holdfast Lamp Guards are the only ones unqualifiedly endorsed by all Fire Insurance Co.'s and Underwriters' Associations



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



CABLE MAINTENANCE AS VIEWED BY A TROUBLE SHOOTER

By O. F. Tallman

Reprinted by permission from *Telephony* of March 28, 1914.

Cable has become one of the most important assets of the telephone business, on account of its ability to reduce the cost of maintenance, and increase the quality of service; and as that word "Service" is the keystone of the telephone industry, it would naturally follow that such an important factor as cable should receive the care and attention due its importance.

It should be installed so as to minimize the chances of trouble. It should be kept clear from trees, guy wires, poles and all objects which might cause injury to the sheath, but when it isn't possible to clear, some suitable protection should be provided.

As I stated above, this precaution should be taken to reduce the chances for trouble, for up to the present time no way has been devised to keep cable clear from all trouble, as some are due to unforeseen causes. That class of trouble can only be taken care of as it appears.

One of the most common causes of trouble is where either the cable itself, or a line feeding through it, comes in contact with a high voltage wire. When this happens to be the cable, the trouble will generally all be found at the point where the contact was made. This trouble may show up at the time by putting from one to all the lines out of service, or it may not show up until some future rain has caused the core of the cable to become wet, through the hole in the sheath caused by the "hot wire."

When "a drop" or line feeding out of a cable becomes crossed with "hot stuff," the high voltage current is carried into the cable, unless protection at terminal checks it, and causes what is termed "scattered trouble," or "inside burns." In this class of trouble one contact with a hot wire may put the whole cable out of service, and the trouble be scattered to the ends of the cable. Experience has proven that a low voltage, say 500 volts, is much more disastrous than high, say 2,300 volts. The 500 volts "lays there and soaks," burning through the points of low insulation, while the 2,300 takes a more direct route to ground, and does not cause so much damage.

Another form of trouble, called "static discharge," is caused from cable not being properly bonded, and will be found at some point where the cable forms a high resistance contact with messenger, hangers or guy wire.

A very common trouble is caused by a sag in the cable, due to too much slack, broken hangers or tie, throwing an unnatural vibration and strain on the sheath, causing it to check and crack or crystallize, leaving the core unprotected.

There are many other ways in which cable may be damaged and service crippled; in fact it would not be possible to catalogue all causes for cable troubles. We might think we had them all, and find the next case to be something unheard of.

The most important thing, when the trouble comes in, is to "get it as soon as possible." A very bad habit, which is practiced so much, is that when only a part of a cable goes bad, say two or three pairs, the first question you hear is: "Can you make any cuts, and get the lines O. K'd?"

This would be all right if the case were followed up, cause located, and trouble cleared; but so long as there is a spare pair available, the trouble is usually neglected, until all the spares are used up. Then perhaps a rain comes, and the whole cable will probably be put out of commission.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



It is not possible to tell the cause of a trouble, until it has been located and examined. It can be guessed at, by past experience, but that is poor policy. I have seen cables as large as 100-pair two-thirds burned, causing only two telephones to be out of service. I have found holes in sheath caused by bullets, nails, spur holes, hot wires, etc., and no lines out of service, holes that had been there from three to six months. As an example: Telephone No. 572 is reported to be grounded. Troubleman goes to terminal where this line works out of, and opens it up for a test. He finds trouble to be in cable, makes cut, and O. K.'s line, which is apparently all that is necessary. But next week it rains, and fifty lines are put out of service. This could have all been avoided if properly attended to at first.

Take a case of "inside burn," that is, when the wires are crossed inside, but no damage to the sheath. Such a case is, apparently, safe enough, and is so far as moisture is concerned, but the insulating properties of the paper have become so damaged, that the current from a generator will very often burn across and damage adjoining pairs. A good comparison would be of that of one bad apple in a barrel of sound ones; unless it is removed, the whole barrel eventually becomes contaminated.

In locating this, and in fact all cable troubles, I find what is known as the Matthews Telefault to be invaluable, because it saves time and expense.

Before this instrument was used, the locating of trouble was slow and very expensive, for it took, in some cases, from one to two days to locate one case of trouble. The usual process was something like this: First, an approximate location was made with a loop meter or galvanometer, then the distance taped off to the point of location, either from the office or terminal, where loops were put on for the reading, then the search began.

If nothing was found, an opening would be made in the sheath, for a test, to determine which way the trouble showed. Another look, then another opening would be made in the direction of the trouble. This ceremony would be accompanied with a prayer for the trouble to be between the two openings. If lucky enough to corner the trouble, the cable would be ridden, and if nothing was discovered, a third opening would be made half way between the two previous ones, and so on until the distance had been reduced to a span or less. If nothing then could be found, a new section of cable would be cut in. The method of today is much shorter.

In some cases where the cable is very long, a location is first taken with the loop meter, then the Telefault Instrument is put on in the office. If the trouble be a ground, one side of the tone is attached to ground, the other to the pair or pairs in trouble. If it be a short, the instrument is looped in series with pair shorted. The object is to form a complete circuit with the tone and trouble to be located.

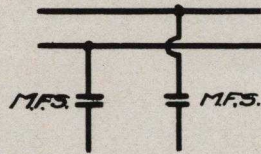
Then with the Telefault Exploring Coil you proceed to the point located by the loop meter test. If the tone is heard at this point, the trouble is farther out; if not heard, it is between you and the office. It is hardly ever necessary to make over three or four tests until the point is found, where the tone stops. The trouble will be found at that point, because the trouble closes the circuit you have formed with your Telefault Instrument in the office.

From three to five cases of trouble may be located in this manner per day.

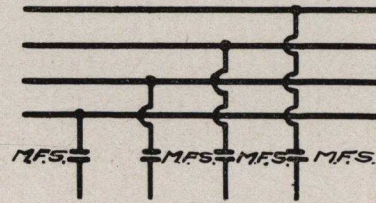
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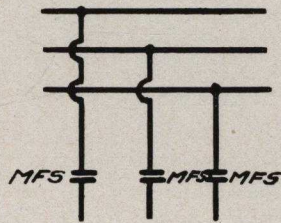
DIAGRAM OF CONNECTION OF MATTHEWS FUSE SWITCHES TO VARIOUS PRIMARY CIRCUITS



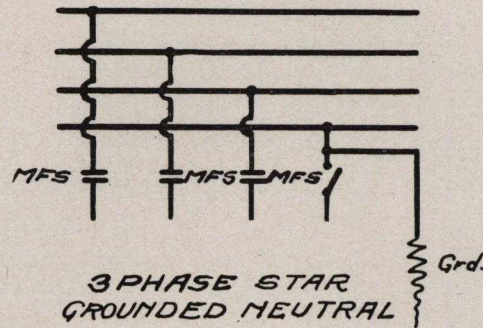
SINGLE PHASE



TWO PHASE



3 PHASE DELTA



3 PHASE STAR
GROUNDED NEUTRAL

GENERAL CONSTRUCTION RULES

All employes should be notified in writing forbidding them to climb any pole belonging to the company or any other company without first testing the pole sufficiently to ascertain its fitness, durability and strength. They should be notified that the company does not make any independent inspection of its poles, but relies upon and expects every employe climbing a pole to determine for himself whether or not the pole is sufficiently strong or sound to justify the employe in climbing it for the purpose of doing any work of any character or description.

Each employe should be expected to inspect all poles before climbing them and no other inspection should be expected of the company.

Foremen incapable of following rules and specifications and producing standard and finished work should be removed. Slipshod, haphazard methods should not be tolerated under any circumstances. Linemen, troublemen and others, should not use spurs on stepped poles, unless the necessity for such use is clearly evident. Any lineman that cuts a pole in order to use a short cross-arm bolt should be discharged.

Sidewalks should be repaired as soon as possible after being torn up. Immediately, if requested to do so by property owners and all places should be left in good order when work is finished. When trimming trees, all limbs and trash should be hauled off as fast as a load of it is cut.

POLES AND FITTINGS

Poles

Right-of-Way.

Right-of-way should be obtained for every pole, stub and anchor, including the wires and attachments to be placed thereon.

Height of Poles.

The height of poles should be as stated in the detailed plans covering each piece of work. In general, exchange pole lines should be constructed of as short poles as is consistent with municipal regulations or with such obstacles as may be met. (See pages 28 and 29.)

Grading of Poles.

Poles should be graded so as to avoid changes of more than five feet in the level of the wires or cables on adjacent poles. In hilly country it is necessary to grade the lines, using poles of different lengths, so that the wires will go up and down hill without making too much of a jump between spans. Poles of proper length should be carried from the yard in order to avoid cutting long poles, if possible. Good judgment in locating and the use of a Matthews' Teleheight will obviate a great deal of cutting. In grading creosoted poles it is proper to cut a pole as a last resort, if shorter poles are not at hand. A difference of one or two feet might be obtained by digging the hole that much deeper. If it becomes a question of cutting, cut off the butt end, not the top. Do not space poles so that they will be placed at the lowest point or at the highest point, but place on either side of the lowest and highest points, as shown in Diagram No. 1, page 157. Where more than fifty poles, longer than thirty feet, are to be put one after the other a Matthews' Polereactor should be used. It will be much more economical than picking them up and will do away with the scars inflicted by the pikes. (See pages 6 and 7.)

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Location of Poles and Anchorages.

Special attention should be given to location of poles, where the ground washes badly, where there are cuts or excavations, and along the banks of creeks or streams. Do not locate poles along the edges of cuts or embankments, but so locate the line that it will have a sufficient amount of solid earth not liable to wash or injure the permanency of the lead.

Setting Terminal Poles.

At the junction of aerial and underground construction the underground lateral should be brought out to a sufficient distance to permit proper head guying. This distance should be sufficient to allow the messengers to pass to the U. G. pole straight and to converge in a common center on the anchor pole. In many cases surroundings must govern the space allowable for this purpose, but in any case it should be your purpose to secure proper anchor room for the messengers and cable leading away from the underground terminal. (Diagram No. 20, page 166.)

Marking Cable Terminal Poles.

Numbers should be placed on the pole at a height of about ten feet from the ground and in a direct line under the terminal they designate. Numbers on wall fixtures in block wiring should be placed on the wall underneath the terminal in such a position as to be easily read from the ground.

Length of Span.

For Heavy Cables: For lines carrying ultimately from a 400 pr. No. 22 gauge cable or a 200 or 300 pr. No. 19 gauge cable, or their equivalents, spans on straight sections should be, approximately, 90 to 100 feet in length; and spans next to end or corner poles should be, approximately, 60 feet in length. Total length should average 95 feet at least.

For Medium Cables: For lines carrying ultimately from 150 pr. No. 22 gauge cable up to a 400 pr. No. 22 gauge cable, or their equivalents, spans on straight sections should be, approximately, from 100 to 200 feet; and spans next to terminal or corner poles should be, approximately, 60 feet in length. Total length should show an average of 110-foot spans at least.

For Light Cables: For lines carrying ultimately less than a 150 pr. No. 22 gauge cable, or its equivalent, spans on straight sections should be, approximately, from 115 to 135 feet; and spans next to corner poles should be, approximately, 60 to 75 feet in length. Total length should show an average of 125-foot spans.

Location of Poles, Stubs and Anchors.

Spacing: Poles, guy stubs and anchors should be located as closely as possible to the points indicated in the detailed plans covering each piece of work. Locations may be varied where necessary to meet local conditions, care being taken to obtain the proper length of spans.

Spacing Poles: In locating pole line, if it becomes necessary to either reduce or lengthen distance between poles on account of obstacles, objections of property holders, etc., the preference should be for the shorter span.

Location of Poles at Street Crossings.

In leading away from the office or the originating end of the line when a cross street is reached, pole should be located on the corners. In this connection, alleys may be regarded as street crossings. This is to permit double-corner effects at all branch leads.



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Locating Poles with Reference to Curves.

When a curve in a line is of such a nature that each pole means a change of direction and no straight-run and corner effects can be worked out, each pole must be anchored and spaced not over 90 feet apart. This applies to all leads except a simple bracket line. Bracket line should be set as above, with guys omitted, to be put on when bracket lead becomes cross-arm lead. (Diagram No. 7, page 160.)

Raking Corner Poles.

In city construction, where buildings are taller than poles, corner poles should be raked the width of the pole at the top. (Diagram 5, page 159.) At all other points where the perpendicular lines of adjacent buildings do not offer a contrast, the corner poles should be raked from 12 to 18 inches, depending upon angle at the corner, load, etc. In no case should a pole be set vertical on a corner. Unless set in soft soil, poles should be raked at time of setting. Three or four poles at least on each side of the corner should be raked, each in gradually decreasing proportion, until the vertical line in the straight line is resumed.

On Streets: Poles and stubs on streets should be set inside of and as near the curb line as possible. Where the curb line is not indicated or where there is any likelihood of its being changed, the correct curb line should be obtained from the city engineer or other authority.

In Alleys: Poles in alleys should be set as close as possible to the side lines of the alleys.

On Property Lines: Poles on streets should be located on or near the property lines, except where property lines are so far apart as to make their sole use impossible in obtaining the proper length of span. As far as possible, care should be taken to so locate poles as not to injure shade trees. As aerial cable turns will usually be made on the messenger, poles may be located merely with reference to the best spacing.

With Wall Wiring: At buildings which are likely to be equipped with bridle rings the poles should be so located as to afford the most direct run for the distributing wires or cable from the pole to the building.

Distribution of Poles.

In distributing the poles, care should be taken to select the heaviest poles for corners and terminals and to place the straightest and best-looking poles on streets and in front of residences. Poles carrying cable boxes should be located so as to be as inconspicuous as possible. Where fifty or more poles are to be erected a Matthews' Polerector should be used. It will pay for itself. (See pages 50 to 54.)

Pole Fitting and Setting.

Trimming: All poles that are rough in appearance should be smoothed, and knots should be trimmed close. Top of pole should be leveled with one cut of saw at right angles to length of pole, and edge should be beveled $\frac{3}{4}$ of an inch with a draw-knife. Poles used with the all-cable distribution should be provided with one gain at the top of the pole. Poles carrying open construction should be fitted with the ultimate capacity of gains.

Stepping Poles.

All poles 30 feet and over in exchange limits should be stepped and equipped with foot blocks. Where creosoted pine construction is used, this will apply to all poles of any height. Only poles at rivers and railroad crossings on toll lines should be stepped. Toll-line test poles should have the foot blocks omitted.

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Framing Poles.

Poles should be raised at the top and placed in a framing buck so that the heaviest sag or curve will be nearest the ground. If the pole be crooked or badly shaped, it should be turned with cant hooks until the best side for framing is brought uppermost and the pole securely chocked. In this position it should first be roofed. Seven inches should be measured from the top of the pole, and this point should be the center of the top gain. The succeeding gains should be spaced 18 inches on centers. Gains should be leveled with a straight edge or sighting sticks.

To bore the holes for cross-arm bolts, a line should be stretched from the center of top of the pole to the center of the pole at ground line and the bolt hole centers laid off from this line. One-half inch holes for pole steps should be bored in pole at right angles to line or in line with cross arms, beginning 18 inches from the top of pole and every alternate 18 inches on opposite sides of pole until a point which will be 7 feet 6 inches above ground is reached. This space should be foot-blocked on the same centers as pole steps. Blocks to be nailed on with one 40 and one 60-penny nails; holes for steps to be bored 2 inches deep, steps driven and screwed with wrench to a depth of $4\frac{1}{2}$ inches.

Much time can be saved by putting the cross arms on before erecting the pole if you use Matthews' Polerector. (See pages 50 to 54.)

Note: In alley leads, poles should be stepped in line with alley as high as 12 to 15 feet; then turn at right angles to alley and continue to the top. This is to prevent liability of danger to top wagons in narrow alleys.

Steps on Cable-Bearing Poles. All poles bearing cable or cable boxes should be equipped with one or two auxiliary steps on the side of the pole in proper position to be used in climbing around the cable or cable box. This position can best be determined after the pole is equipped or at the time that the need for these steps develops.

Butting Poles. Every pole should be squared across the bottom before setting. This should be done with a cross-cut saw, and not with an ax.

The following specifications are recommended for the depth in feet of holes for setting poles under different conditions:

Height of Poles	SOLID GROUND		SOFT GROUND		SOLID ROCK
	Depth of Poles		Depth of Poles		Line or Corners
	Line	Corners	Line	Corners	
22	5	5	5	5	3
25	5	$5\frac{1}{2}$	$5\frac{1}{2}$	6	3
30	5	$5\frac{1}{2}$	6	$6\frac{1}{2}$	$3\frac{1}{2}$
35	6	$6\frac{1}{2}$	$6\frac{1}{2}$	7	4
40	$6\frac{1}{2}$	7	7	$7\frac{1}{2}$	4
45	$6\frac{1}{2}$	7	7	$7\frac{1}{2}$	$4\frac{1}{2}$
50	7	$7\frac{1}{2}$	$7\frac{1}{2}$	8	$4\frac{1}{2}$
55	$7\frac{1}{2}$	8	8	$8\frac{1}{2}$	5
60	8	$8\frac{1}{2}$	$8\frac{1}{2}$	9	$5\frac{1}{2}$
65	$8\frac{1}{2}$	9	9	$9\frac{1}{2}$	$5\frac{1}{2}$
70	9	$9\frac{1}{2}$	$9\frac{1}{2}$	10	$5\frac{1}{2}$

Guy stubs should be set not less than 7 feet in any soil except solid rock.



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Size of Holes: The holes should be large enough to permit the free entrance of the poles without hewing or stabbing, and should be full size at the bottom, so as to admit of the use of tampers.

Tamping Pole Holes.

All pole holes, except those in very hard gravel or rock formations, should be tamped so thoroughly that the necessity for hauling away excess dirt is obviated. Four or five energetic tampers and one slow shoveler will accomplish this. Great care should be taken that the shoveling in is not done so fast that the earth can not be properly tamped. This is frequently the cause of much trouble; and while it expedites the erection of the poles, it causes much loss of time and money later, on account of pole giving way when placed under strain.

Protecting Poles.

Where corner poles or other poles are exposed to injury from whittling, pole butt should be well painted and heavily sanded. If this is not sufficient in any special case, the pole butt should be wound with No. 10 galvanized wire, spaced $\frac{1}{2}$ -inch apart, painted and sanded.

Painting Poles.

The top and gains of all poles should be painted with one coat of approved paint. All poles which are protected by strain plates or shims from the cutting of messengers or guys should be painted with one coat of approved paint on the space occupied by the strain plate. Where specified or where required by the authorities, poles should be painted with approved paint. All paint should be uniform in color.

Reinforcing Existing Pole Lines: When cable is to be strung on an existing pole line, the line must, where necessary, be strengthened to carry the proposed load by replacing badly rotted or weak poles. Especially careful inspection should be made of poles on corners and curves and of guys. Excessive spans should be reduced by the addition of extra poles. (Diagram 6, page 159.)

Facing Arms. (City Construction.)

At long spans the cross arms should be placed on the side of poles away from the long spans. Arms on cable poles should face the office or the originating source of the lead. The next pole ahead of cable pole should face the same unless it be a corner pole; then it should face the corner. At the terminals of a lead the last two poles should face away from the office. On corners arms should face the point of intersection of curb lines, thus facing each other. First arm each side of the corner should ordinarily face the corner. Where lead changes side of street, arms should face each other as in corner work. At railroad crossings arms should face away from the railroad.

On Curves.

Arms each side of center of curve should face the center of curve. All other arms, except the above indicated, should face away from the office. (Diagram No. 8, page 160.)

Facing Cable Arms.

Cable arms should be placed on the same side of the pole that the standard arm is placed.

Arms should be fitted with their full complement of pins.

Insulators should be put on when line is attached and taken off when line is removed. Cross-arm bolts should be long enough to prevent any chopping of pole to get nut and washer on.

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Braces and Cross-Arm Fitting.

Cross arms should be fitted with a standard cross-arm brace. This brace should be fastened to the arm with $\frac{1}{4} \times 4\frac{1}{2}$ carriage bolts, and to the pole with drive screws ($3\frac{1}{2}$ inches).

Arms should be sighted and leveled at right angles to pole length, and not parallel with the ground. This includes all corner poles, no matter what the degree of rake.

A spirit level should not be used for leveling arms.

The arms should be fastened to the pole by means of one standard cross-arm bolt. Each pair of cross-arm braces should be fastened to the pole by means of one standard $3\frac{1}{2}$ -inch drive screw, driven $2\frac{1}{2}$ inches, screwed the balance.

Care should be taken that arms are placed at right angles to the length of the pole.

Brace for Twenty-five-pair Cable Poles.

When the regular type of twenty-five-pair cable pole is used, a cross-arm brace should be placed under the top arm and the arm carefully squared at right angles to pole before perpendicular strap braces and other arms receive final adjustment.

Buck Arms.

Buck arms should not be made under any circumstances.

Double-arm Construction.

Arms at River Crossings: The alternative of double and blocked arms may be a standard arm backed and reinforced by an angle iron arm, the standard arm being set in the angle iron arm and bolted to same; angle iron, $3 \times 3 \times \frac{1}{4}$.

Canting Arms on Corners.

When a lead makes a double corner or changes from one side of the street to the other, the last arm should set at right angles to the line of direction leading to the corner, and the first arm leading away should set at right angles to the line of direction leading away from the corner. (Diagram 9, Fig. 1, page 161.)

If the change of direction forms an angle of less than forty-five degrees, one or both corner arms may be canted slightly to secure the greatest space between lines. This should not be permissible where the angle is forty-five degrees or over. (Diagram 9, Fig. 2, page 161.)

Canting Arms on Single-pole Corners.

The arm should set in a line that will divide in half the angle formed by the two lines of direction of the route.

On curves the inside ends of the arms should point to the common center of a circle of which the lead curve forms the circumference.

Single-pole corners are not desirable and should not be used when the pull is over 20 feet, unless it is an unavoidable case. (Diagram 9, Fig. 3, page 161.)

Back Braces.

At corner poles where the pull is 12 or more feet and at right angle corners regular pipe brace should be used at toll-line terminal poles, and also at exchange terminal poles where there are no distributing or service wires extending in the opposite direction to the line wires.



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AERIAL CABLE CONSTRUCTION

Size of Cable Messengers.

For No. 22 Gauge Cables.

50-pair or smaller.....	25-pair and smaller.....
60 to 190-pair.....	50 to 100-pair.....
200-pair and larger.....	100-pair to 200-pair, inclusive.....
	300-pair and larger.....

For No. 19 Gauge Cables.

25-pair and smaller.....	6,000 lbs.....
50 to 100-pair.....	10,000 lbs.....
100-pair to 200-pair, inclusive.....	16,500 lbs.....
300-pair and larger.....	22,500 lbs.....

Breaking Strain
of Messenger.

Diameter of
Messenger.

6,000 lbs.....	5/16-in.
10,000 lbs.....	3/8-in.
16,500 lbs.....	7/16-in.
22,500 lbs.....	7/16-in.

Height of Cable Crossing.

At highway crossings, cable should clear highest point of roadway 20 feet; at railroad crossings, height should be obtained from the manager. In no case should this height be less than 28 feet from the rail. Use Matthews' Type C Teleheight. (See page 29.)

Safety Strap at Corner Poles for Messenger.

At corners, where pull is away from pole, safety strap should be used, as shown in Diagram 15, page 164.

Cable messenger should be carried at the lowest level permitted by municipal regulations and existing conditions of foreign wires, cables, balconies, verandas, etc. (See page 130.)

Height of Main Leads.

Main leads should be laid out with reference to branch or cross leads, and no main lead should be laid out until a thorough study has been made of all cross leads. The height of the main lead should be adjusted, if possible, to meet the requirements of the branch or cross leads. (See page 130.)

Changing Messenger Level.

If the level of cable messenger is to be changed for good reasons, it should not be dropped abruptly, but should be graded carefully to meet requirements.

Down Strain on Messenger and Supports.

No cable messenger should pass inspection that is pulled downward from the last support in going to anchor, or, as in case of cross leads, causing a downward strain on the feeder messenger, if it can be shown that the messenger could have been carried level.

Serving Out at Dead Ends.

In ordinary practice, sufficient end should be left in messenger or guy to pass twice around the pole to permit the distance given elsewhere between end of clamp and pole and to allow a standard length of 18 inches from clamp to free end. This free end should be carefully straightened, laid alongside of the main messenger, and served with bands of No. 14 iron wire spaced 6 inches apart.

Where several guys or messengers dead-end on one pole, the ends and servings should fall in line.

Steel strand is very hard to cut on a pole, and it is impossible to more than approximate the length to cut on the ground. The best method of procedure is to make the dead end, put on the serving bands the specified 18 inches, untwist the remaining free end, bend the single wires one at a time back sharply against the serving two or three times quickly, then with a twist snap off. This method will be found quickest and will leave a neat, clean finish on the end of the strand. (Diagram 14, Figs. 1 and 2, page 163.)

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Adjusting Messenger Level.

If, after the preliminary pull is made on a messenger, it can be seen that the grade might have been better, it should be considered of sufficient importance to raise or lower the messenger support or supports necessary to bring this about. The fact that it might take a few minutes to change a hanger should not be considered an excuse. (Use Type C Matthews' Teleheight.)

Putting on Cable Arms or Supports.

If a street is level and all other conditions are favorable, messenger supports may be placed on the poles by tape-line measure from the curb to the determined height. The use of Type C Matthews' Teleheight for this purpose will be more economical and safer. (See page 130, "Safety First Warnings.") If streets are rolling and other conditions unfavorable, the tape should be discarded, and light lath-sighting sticks should be tacked on the pole, raised or lowered until a satisfactory grade is assured, and messenger supports placed at these points. In either case, as above specified, the preliminary pull on messenger is to determine the correctness of the spacing of the supports. If view is obstructed by trees, a No. 14 wire may be stretched through at the approximate level and adjusted to satisfactory grade. The pulling line may then be dragged through with the No. 14 wire.

Dead-Ending Messenger.

Messenger should be pulled from anchor stub to anchor stub without a break if possible; and in no case should it be dead-ended on the pole ahead of the anchor stub and short piece carried from this pole to anchor, except if stub is self-supporting, or for reason that can not be remedied, the stub is much lower than the general cable level.

Messengers Level at Cable Boxes.

In general the messenger should terminate or pass under the bottom of cable box. This should be excepted if such a procedure would cause too abrupt a dip in messenger level. In such case messenger should be carried above the box, and branch to the box cleated down pole and formed into goose neck, as in ordinary practice.

Dead-ending cable messenger on cable arms or messenger supports should be absolutely prohibited. Such dead ends should be made on body of pole.

Messenger Turning Corners.

Messenger should never turn double corners or change from one side of street to the other by being pulled around the corner. On double corners, messenger and cable should make the square turn. (Diagram 15, Fig. 1, page 164.)

Changing sides of street, messenger should go straight past last pole to stub and anchor; it should begin again on opposite side of street in same manner, both corner poles side guyed and gap in messenger filled in with short pieces. (Diagram 15, Fig. 2, page 164.)

Dead-Ending Messenger on Stub, Illustrated by Diagram 21, page 167.

A pair of 6-inch triple blocks should be hung on the guy stub or terminating pole and slack taken out of the messenger, the end thereof being carried around the pole loosely and fastened with a Matthews' 2-Bolt Clamp for safety. Next a 10-inch snatch block should be hung just above the guy shims on the side of pole parallel with the curb. It should be secured to the pole with the equivalent of four turns of inch Manila line. Next a piece of $\frac{3}{8}$ -strand measuring $1\frac{1}{4}$ spans, approximately, should be attached by means of a Matthews' 2-Bolt Clamp in a permanent manner to a C. C. clamp. This clamp should be attached to the messenger approximately 15 feet from the stub, and the Hickey



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attached to the clamp should be carried through the snatch block to the butt of the next pole or some convenient tree or other sufficiently firm object. A No. 1200 Matthews' Anchor may be used to advantage for carrying this temporary strain as it can be backed out when the work is finished. (See pages 9 and 62.) A pair of 10-inch triple pole-hoisting blocks should be made fast to this pole or other objects with a lashing of not less than two turns of 1¼-inch line or its equivalent. These blocks should be hooked to the strand leading over the snatch blocks, with the blocks spread at least 30 feet. A pair of luff blocks should be attached to the fall of the main blocks by a stopper hitch, allowing the main fall to be snubbed around the nearest solid point of support. A team should be hooked to the fall of the luff blocks. When the desired tension is secured, the main fall should be permanently snubbed, and the messenger may be considered as in position to make fast. The loose end should be passed twice around the pole, the free end hooked to one end of a pair of 6-inch triple blocks, the other end of which pair should be secured to the main messenger. The fall of these blocks should be carried through a second and smaller snatch block to the ground, where it may be handled by means of sufficient luffs to take out all slack back of the C. C. Clamp. When this is done, the messenger is secured by one Matthews' 2-Bolt Clamp lined up with the center of the pole; and the distance from nearest clamp to pole should be not less than 12 inches for poles 10 inches in diameter, not less than 18 inches for poles 10 to 15 inches in diameter, and not less than 24 inches for poles 15 inches and over when these clamps are set up. (See Diagram 15, page 164.)

The tension on the main blocks must be eased off very gradually, and with caution, until the dead end has the full strain.

As soon as this is accomplished, some one ought to be sent over the line to tighten up the clamps on each messenger support.

In making the two turns around the pole, both with messenger and guy, the practice of forming the convolutions into a tie is considered best. The two turns should pass around level, and, as the strain is applied be driven down until a snug, even fit all around is secured. Where this method of procedure can not be used, the old practice of hanging blocks on the pole may be permitted. (Diagram 21, page 167.)

Staples.

In making any dead end of messenger or guy, the use of staples is entirely unnecessary, and this practice should be discontinued. In general practice the two turns around the pole should be made, one end of the blocks attached to the body of the messenger or guy and the other attached to the free end of same, the fall of the blocks passed back and down to ground over a convenient step or snatch block.

Luffing.

All anchor guys, head guys, corner guys or any guy holding a strain of more than one arm of No. 14 wire should be pulled with two sets of guying blocks, one being used as a luff for the other set; and, if necessary, a second luff should be applied. A temporary strain guy may be put on to pull against, the object being to get all slack, or "give," entirely out of guys or anchors before strain comes on. A No. 1200 (12-inch) Matthews' Guy Anchor should be used for these temporary strains, as it can be backed out and used over and over again, for similar purposes elsewhere. (See pages 9 and 62, and Diagram 21, page 167.)

Pulling Messenger in Long Stretches.

When pulling long stretches of messenger, booster blocks should be used at different points at intervals in the length of messenger. In straight-line work, one or two sets between the main blocks and the distant end of the messenger; if any decided corners appear, a supplementing pair of blocks should be used at each corner.

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Breaking Sizes of Cable Messenger. If a cable tapers in size, the messenger should not be tapered unless the smaller cable exceeds 500 feet in length, viz.: If a 100-pair cable tapers into a 50-pair which extends 500 feet or less and terminates, it is best not to change the size of the messenger because of the cost of dead-ending the strand.

Where it is necessary to change the size of the messenger, the two should be united and guyed at the pole where the cable tapers. (See Diagram 19, page 166.) When the cable becomes smaller and the messenger does not, the messenger at the pole at which the cable tapers must be guyed to the next pole away from the larger cable. Where it is impractical to guy to the next pole, a No. 603R (6-inch) Matthews' Guy Anchor should be used at the discretion of the foreman. Where steel cross arms are used the messenger should not be tapered or head guyed.

Splicing Messenger. Messenger can be spliced most easily and securely by means of thimbles and Matthews' 2-Bolt Guy Clamps as shown in Diagrams 17 and 19, pages 165 and 166. Splice should be made just where it occurs and not be forced arbitrarily to come on a pole. Another way is shown in Diagram 15, page 164.

Sag of Cable Messenger. In spans of 100 feet or under, messenger should have not more nor less than $1\frac{1}{2}$ inches sag for cable from 100 to 400 pairs. For smaller cables, messenger may be stretched somewhat more tightly.

Loaded messenger should not have over 1-inch sag per 10 feet of length, 9 inches in 90-foot span, 10 inches in 100-foot span, 12 inches in 120-foot span, and so on.

Painting Cable Messenger. All cable messenger, clip ties, cable arms, and cable anchor guys and clamps should be painted with one coat of approved iron-preserving paint, where conditions warrant it. This paint should be renewed at intervals as may be made necessary by exposure, wear, etc. This should apply to towns of over 5,000 inhabitants, or at points where it may be deemed economical by the management. Splices and clamps at dead ends in all cases.

Steel Cable Arms. Steel cable arms should be put on with one $\frac{5}{8}$ -inch bolt through the center of the arm, in addition to the 2-bolt and back piece as in ordinary cross-arm practice and the strap braces should be fastened with $\frac{1}{2}$ -inch bolt through the pole.

On corners, at the head of lead, and at any point where a heavy down strain may occur on messenger, two cable arms should be used on the pole, with three bolts—one through the center, one at each end. All bolts should be set up as tightly as possible. All cable cross-arm braces should be attached to pole above the cable arm.

Messenger Supporting Clamps.

Messenger Supporting Clamps should be attached to the pole in straight-line work, with one cross-arm bolt through the bottom hole and one Fedder Drive through the top hole. On curves and corners two cross-arm bolts should be used. The cross-arm bolt should be put through the Messenger Supporting Clamp, then through the pole, making it possible to put on another on the opposite side without removing the bolt. If Messenger Supporting Clamps are used on a lead, arms of required capacity may be placed on all abrupt corners, so that the trouble and expense of handling loaded messenger on corners may be avoided at the time of such change.

When the evident ultimate cable requirements of a lead will not be over two messengers, Messenger Supporting Clamps should be used.

When the evident requirements will be several messengers, cable arms of estimated capacity should be installed at first.

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REINFORCEMENT

Storm Guying Toll Leads.

On country lines that are exposed to sleet and wind, every tenth pole should be guyed and anchored four ways with No. 502R (5-inch) Matthews' Anchors. This will not cost much, but like fire insurance its value will be greatly appreciated when the dreaded time comes. (See photograph on page 56.)

Guy Strand.

All anchor guys for steel messenger or side guys against steel messenger strand should be of the same strength as the messenger. Six thousand-pound strand should not be used as messenger or messenger guy or for anchor guys for messenger.

Height.

Guys should be so placed as to meet the requirements of any local ordinance that may be in force, and so as to afford in all cases a clearance of at least 18 feet over driveways and 8 feet over walks. Use Type C Matthews' Teleheight to determine heights. (See page 130.)

Guying Cable Leads.

All guys on cable leads to support messenger strains should be placed as follows:

If a single messenger on a messenger supporting clamp, guy should be placed above and as close to messenger as possible. If it be a lead of several messengers on arms, all guys leaving the pole in a horizontal line should be placed above the messenger and as close as possible.

Guys should be wrapped about the pole or guy stub, and should be held with Matthews' Boltless Guy Clamps. With 6,000-pound strand, one Matthews' Giant Boltless Guy Clamp only is needed; with 10,000-pound strand, one Matthews' 2-Bolt Clamp should be used; with 16,500-pound strand, one Matthews' 2-Bolt Clamp should be used when the guy is dead-ended on a pole or stub, or when the guy is dead-ended on a thimble.

Guying Corners.

The top guy should in all cases be placed immediately under the top cross arm between the brace and cross arm. This relates alike to the head and side guys on double or single corners.

A second set of guys should be added when strain on pole justifies, and should be placed under the third or fourth arm, according to judgment of man in charge of construction.

Heavy Leads on Steep Grade.

When a heavy lead of overhead wire or cable or a combination of both is carried up a 10 per cent grade or greater, it should be strain-guyed every third or fourth pole, according to grade, load, etc., up and down the hill. Some cases might require this treatment on every pole. It is not necessary on gentle grades or levels except as specified elsewhere, covering storm or safety guys. (Diagram 6, page 159.)

Guying Distributing Pole in All Cable Work.

If the load of service wires is very much to one side, causing pole to lean, it should be guyed to prevent this, with 5/16 guy strand and attached to a 502R Matthews' Anchor by means of Matthews' Baby Boltless Guy Clamps.

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Guying Lead of Seven Arms and Over.

When a lead carries seven arms or more the corner, line, head and strand guys should be of 9/32 steel. Any anchor guys should be of $\frac{3}{8}$ steel. Side or wind guys at cross streets should be of 5/16 guying strand. Guys should be placed under first, third, fifth and seventh arms.

Care should be taken to properly guy all corners where branch routes or cables turn from the main route. Guys should not be located on private property unless with written permanent permission obtained on regular right-of-way blanks. Property owners rarely object to the use of Matthews' Guy Anchors, because they can be screwed in in a few minutes without digging or injuring their lawns. (See photographs on page 61, and letters Nos. 1, 2 and 3 on page 64.) The ends of all pole lines should be properly anchored, whether the pole line at the end is carrying one pair of wires or more. Proper attention should be given to strengthening corners and guying when an exchange increases and more wires and cable are added to the routes; otherwise work originally sufficient for the purpose intended and in good shape when constructed will rapidly go to pieces. The man in charge should be held responsible for leads that have been overloaded by growth and have not been provided with additional guys and anchors.

Tree and building guys should be used only when no other arrangement is possible and with written consent of property owner.

When so used, tree should be protected with blocks, and guy should pass only once around the tree, and the loop should be left very large.

Buildings so used should be protected from mechanical damage by the guys.

Guying Heavy Leads Against Side Swing.

Leads carrying a heavy load of cable or overhead construction should be side guyed in both directions at convenient cross streets to prevent side swing from wind pressure. (Diagram 3, page 158.)

Cutting Steel Strand.

Steel strand should be served with two or three turns of insulating tape on each side of the point where it is to be cut to prevent untwisting. Serving should be put on before cutting.

Truss Guys.

Any cable span over 200 feet should be truss guyed. If more than one cable is involved, a double truss-supporting iron cable arm should be used. Whenever local conditions are such that no other arrangement may be made, such as spanning property where poles are forbidden, crossing public squares of small towns, truss guys may be used for spans up to 500 feet. (Diagram 10, page 161.)

Truss poles should be storm guyed. (Diagram 3, page 158.)

Long, Heavy Cable Leads.

Very long and heavy cable leads should be storm guyed every five poles, and at least one pole near the center of the run should be anchored in both directions with half tap to messengers; $\frac{3}{8}$ steel strand should be used for this purpose. (Diagram 2, page 157.)

Route should be strain guyed immediately on either side of a railroad crossing, or any extra hazardous risk to open construction, from butt of first pole on each side to top of next pole ahead. (Diagram 1, page 157.)

Guys, Clearing Pole Steps.

No guy or guy shims or hooks should be placed on a pole so as to come in contact with pole steps. A clearance of 3 inches should be the standard.

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All guys should be placed on poles as near to the point of strain as possible, and where several guys concentrate on one pole they should be assembled as closely together as possible, but should not overlap or bind each other.

The common practice of leaving from 1 to 3 feet between terminal of guy and point of strain should be discontinued.

Backing Up or Strain or Storm Guying (Called "Pole Guying").

In head guying or strain and storm guying, the guy, when it is fastened to the butt of pole, should be as close to the ground as possible, but not nearer than 8 feet. (Diagram 2, page 157.)

Side Guying a Corner. (Special.)

Where the anchorage is well ahead of a right-angle line, the top of the corner pole should be free from lines. A guy should be placed just under the top arm, carried to the butt of the first pole behind, and pulled tight and fastened in a permanent manner. A second guy should be put immediately underneath the first and carried to the anchorage point to the side or ahead. This guy should then be pulled against the back guy until the top of pole is raked at least 30 inches, when it should be permanently made fast. Lines may then be pulled just enough to take tension off the corner pole. (Diagram 4, page 158.)

Side Strain on Stubs.

Guy stubs should not be left with any side strain whatever.

Side strain can be prevented in two ways—by side guying stub itself or by putting pull off in guys on messengers leading away from stub.

Anchor rods, stubs and point of strain should be in line. Where this is impossible it must be taken care of as above. (Diagram 4, page 158.)

Use of Guy Hooks.

Any guy that runs downward or upward at an angle of forty-five degrees or less should be kept in place by guy hooks on the pole. If it be a strain guy from butt of one pole to top of next pole, hooks should be used at both ends, those on the pole butt being turned upside down to prevent guy slipping up with strain. Smallest size hook should be used for this purpose.

Moving and Changing Guys Under Strain.

No attempt should be made to move or change a guy under strain until after a temporary guy has been substituted and pulled until the guy to be moved has slacked sufficiently to show that the temporary guy has the strain. If it becomes necessary to tamper with anchor guys, temporary guys to some convenient pole butt or tree should be put on sufficient to cover all loss of strength involved by the operation at hand. In each case a temporary guy of higher strength than the one to be removed or handled, must be put on, and one for each guy that is to be moved or handled. Accident as the result of failure to observe the above should be regarded as criminally careless and dealt with accordingly.

For this purpose a No. 1200 (12-inch) Matthews' Guy Anchor should be used, as it can be screwed in and backed out when no longer needed. (See pages 9 and 62.)

Side Guys for Cable Messenger.

All guys acting on steel messenger should be of the same strand as the messenger, and should be attached to the pole at a distance of not more than 6 inches above the messenger, and closer if conditions permit, or as shown in clause for "Guying Cable Leads." (Page 147.)

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Dead-ending Messenger on Self-supporting Stub.

If it becomes necessary to dead-end messenger on a self-supporting stub, a Matthews' Anchor must be put in behind the first pole ahead or, if this is not possible, on the second; and the messenger should be pulled from this anchor to the end and made fast. A short length should then be run in for the one or two spans to the self-supporting stub. This should be permanently attached to the main messenger 6 feet ahead of the anchor pole with Matthews' 2-Bolt Clamps (as shown by Diagram 15, page 164), and should then be pulled to the stub with as great a strain as the stub will stand.

It should be the duty of the foreman in charge to consult the manager before placing a self-supporting stub for the purpose of dead-ending messenger. A self-supporting stub should not be used until all other resources are exhausted. (Diagram 13, page 163.)

Dead-ending Several Guys or Messengers in Limited Space.

In dead-ending a number of guys in limited space, the clamps should be staggered or alternated to prevent excessive piling up at any one point.

Dead-ending Messenger on Backed-up Poles.

Messengers should not be dead-ended on poles back guyed from pole to pole until all other efforts to locate proper anchor have failed.

Terminating Messenger.

All cable messengers should be anchored at the terminating pole. Pole guying should not be used unless it is impossible to get down a Matthews' Anchor. When pole guying is used, the terminating pole and next pole should be ground braced. (Diagram 13, page 163.)

Guy Stubs.

A guy stub in no case should be smaller in diameter at butt or top than the pole it supports, and should be as straight as possible on account of the tendency to buckle. A stub at the head of heavy cable leads should be as massive as possible throughout its length. Never use an inferior guy stub at any important point.

A guy stub should be raked to position before filling hole, and should not be set straight and raked with the anchor guys. In the proportion that stub is curved or buckled its strength is decreased. No stub should be raked less than 24 inches.

Guy stubs holding a strain greater than a one-arm lead should measure 12 inches across the top or more, if procurable.

Guy stubs for dead-ending messenger should be of sufficient height to permit of the messenger being carried on a dead level, or at least an imperceptible grade.

Distance of Matthews' Anchor from Stub.

When possible, the anchor should be placed at a distance from the stub that is equal to or greater than the distance from the guy to the ground level, which will give anchor guys an angle of forty-five degrees or more. As the distance between anchor and stub is lessened, the greater the degree of rake of stub should be, as shown in Diagram 12, Figs. 1, 2 and 3, page 162.

Poles and important guy stubs should be stepped and blocked after being set before any further work is begun on them.

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Guards for Anchor Guys.

Where municipal regulations require it, box guards may be provided for anchor guys.

Guy stubs and anchor poles should be provided with 4-pole steps on a level with each other around the pole, quartering the same about 4 feet below the point of contact of messenger and guys, for linemen to stand upon while adjusting guys. This enables men to work to better advantage and prevents the gaffing of poles.

Strength of Anchor Guys.

For every messenger terminating on one stub a double-anchor guy of the same strand or the equivalent should be used. On any anchor stub the total breaking strain of anchor guys should be at least one-half greater than the combined breaking strains of all guys fastened thereto.

Foundations for Guy Stubs on Heavy Corners.

Guy stubs and corner poles that are subjected to a heavy, thrusting strain should be provided with a foundation block.

Light stubs and corners in rock, or clay, should have the bottom of the hole well packed with tampers before pole is set.

In very soft soil formation, all corners and stubs should be provided with foundation blocks.

Strain Plates and Guy Hooks.

On all poles or stubs where steel-stranded messenger dead-ends or extra heavy guying proposition occurs, strain plates and guy hooks should be used.

ANCHORS

Location.

In locating anchor guys the distance from the ground-line of the pole to the Matthews' Anchor should be one-third ($\frac{1}{3}$) the total length of the pole, where possible, and in no case should it be less than one-fifth ($\frac{1}{5}$) the total length of the pole.

For country work the 5 or 6-inch Matthews' Guy Anchor, or anchor down in solid rock, as specified elsewhere.

For exchange construction, for stubs holding corners, and for terminating cables under 100 pr., the 6 or 7-inch Matthews' Anchors are generally used—one or two (see photograph on page 57 for best method of using two of these anchors) according to the amount of the load. For cable leads, if the ultimate number of cables is to be 200 pr., one 8 or 10-inch, or two 6 or 7-inch Matthews' Anchors should be used in the beginning, put down as specified elsewhere. All leads that will carry more than one ultimate of two 200 pr. cables should be referred to the general manager or some competent engineer to pass upon. Or taken up with W. N. Matthews and Brother, Inc.

When two anchors are used, two sets of guy hooks should be used—one set at the top of the strain plates, one at the bottom—and one set of anchor guys in each rod. (This is where one anchor is placed back of and in line with the other.)

If rod eyes are in line one above the other, one set of guys should be placed in each eye. If rod eyes are abreast, one-half of the upper and one-half of the lower set should be placed in each eye.

It is unnecessary to use thimbles in the eyes of Matthews' Anchors. Where any other type of anchor is used thimbles should be used.

Anchors should be buried to the eyes. Anchors deeper than this will be O. K. if guys are painted. A Matthews' Ratchet Handle will make it easy to do this under all conditions with Matthews' Anchors. (See photographs on pages 59, 60 and 61.)

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Half-tap Anchors.

When a heavy lead of cable originates at one point and leads all in one direction from one Matthews' Anchor, a second anchor should be placed, approximately, 750 feet from the main or head anchor and each messenger half-tapped to the secondary anchor.

Anchor in Rock for Cable Leads.

Proceed with the excavation as though preparing to set ordinary pole. When rock is reached, blast out until a 3-foot depth in rock is reached. The anchor rod should be passed through a steel plate 9"x9"x $\frac{5}{8}$ " and two nuts screwed on tightly. The rod should be placed in position in the hole and carefully adjusted to the proper angle. When this is assured, the hole should be filled to the surface of the rock with a mixture of concrete, consisting of two parts of Portland cement, three parts of sand and four parts of broken stone. This should be turned three times before water is added and once after wetting to insure thorough mixing, and must be tamped in the hole carefully. The hole should be left open for at least thirty-six hours before subsoil is thrown in and tamped. This anchor should be put down at least one week before putting strain on same. No attempt to smooth the sides of the rock hole should be made, as a rough or jagged effect will best hold the concrete filling.

Note: Portland cement or its equivalent should be used.

Rock Keys.

Rock keys should be used only for the lightest form of construction work—as for instance, subscribers' side leads.

Toll leads, cable messenger or heavy subscriber leads should not be anchored to rock keys.

Regular Twenty-five-pair Cable Pole.

A regular twenty-five-pair cable pole should be guyed as shown in Diagram 13, page 163, when the lead exceeds three spans in length. If for three spans only or less, the strain guy ahead of cable pole can be omitted. If one arm or more of wire drop off one pole, that pole should be head guyed against the pull of these lines, guy being put under the arm if only one arm stops, and under the upper one if two arms stop on one pole. If at time cable is opened and one arm or less of wires are in commission, the second head guy should be omitted; and if lead is under three spans, strain guy should be omitted. If over three spans, the second head guy should be omitted, but the strain guy put on.

CABLES

Handling Cable Reels.

Great care should be taken in handling cable reels in carrying to the works and in delivering from depot to warehouse. Cable should not be dropped from platform or wagon. Cable reels should **never** be laid on the side. Should be rolled in direction of arrows painted on side of reels.

If public draymen haul cable from depot to warehouse, loading and unloading should be done under personal supervision of some one in the employ of the company who understands the handling of cable.



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Laying Out Cable.

Whenever it becomes necessary to carry a number of cables on one lead, it should be remembered that two cables of a given size are heavier than one cable of twice the capacity in one sheath, and, in addition, requires a separate messenger, and increasing the dead weight to be carried and the strain on anchorage, guys, etc. See the following table:

If two 200 pr. cables needed, carry 400.

If two 50 pr. cables needed, carry 100.

If two 100 pr. cables needed, carry 200.

If two 50 and one 100 pr. cables needed, carry 200.

This should apply in any combination of cables running parallel on the same lead. These figures should be used in reconstructing old plants as well as in new layouts.

Heavily Loaded Country Routes.

On pikes carrying a heavy lead of subscribers and where it seems difficult to locate a twenty-five-pair cable box with a view of allowing a proper per cent for growth, a fifty-pair box should be opened at the terminus of the cable lead.

Branching Cable.

Unless some peculiar condition enforces otherwise, branch cables or through cables leaving a main route should feed off in such shape that they will not cross over or under other cable.

Cable that is to feed to the right should be carried on the right-hand side of the lead, if possible.

Cable that is to feed to the left should be carried on the left-hand side of the lead and through cables in middle, if possible. (Diagram 22, Fig. 1, page 167.)

Protecting Cable Pole Grounds from Mechanical Injury.

A cable pole or other ground may be passed through an iron pipe for mechanical protection, provided that the conductor is carefully wiped to the iron pipe at both ends where it enters or leaves the pipe. This is for extreme cases. Unless for some extraordinary reason, cable pole grounds need no protection beyond placing them on the side of pole away from exposure to wheel hubs, etc. Staples can be spaced 1 foot apart to a height of 6 feet, and in ordinary practice no other protection is necessary. Poles should not be gouged out to accommodate ground wires.

Hanging Cable.

When the messenger is ready for the cable, Matthews' Cable Rollers should be placed in position on the messenger, spaced generally 15 feet apart and not more than 20 feet at any time.

The cable reel should be placed approximately one span from the beginning of the run. A temporary leading-up guy should be placed in position and equipped with rollers. The drag line should be brought through all the rollers from the distant end of the run and attached to the cable by means of a Universal Cable Grip. The cable should then be pulled through by means of a team crab or capstan.

After the cable has been run out, one end should be made fast, a pair of heavy blocks with a luff attached to the other end, and all the slack pulled out before snubbing. This is important.

Cable Area.

A cable area is the section fed by any one cable and should be as compact as possible, economy and existing conditions being considered. Cable areas should not overlap or interlock each other if any other solution of equal economy is possible.

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Snubbing Cable.

Two strands of No. 10 or its equivalent of No. 14 iron wire should be laced on the cable and attached to the pole or fixture at the end of same. If cable stops in the span, the attachment should be made to a Matthews' 2-Bolt Clamp temporarily put on the messenger. In any case great care should be taken to avoid crimping the sheath or choking the cable. Snubbing with pieces of rope put on with half hitches should be positively forbidden. (See Diagram 22, page 167, for correct way.)

Passing Cable Around Corners.

Cables should not be pulled around corners unless the cable terminates within one span of the corner. If the run is greater than one span, cable should be cut and spliced.

Pot-head Wire for Submarine Cables.

Pot-head wire for submarine cables should be of braided rubber-covered wire of the same gauge as the conductors in the cable.

All terminal branch taps should be brought out from a Matthews' Joint, and should be cleated to the pole with lead cleats, the top cleat being spaced 9 inches below the pot-head, other cleats spaced 1 foot apart. Any slack will be arranged in the curve from pole to main cable.

Testing for Slipped Sheath.

When a length of cable is pulled in, it should be the duty of the foreman to ascertain if the sheath has slipped on the cable. This can be done by piercing a small hole near the end, which will be sealed after the inspection if found O. K. If it is found that the sheath has slipped, it should be cut back until the cable is found and the end sealed with solder.

Lapping of Sections.

A 3-foot lap of sections for splicing is all that is necessary. This does not mean 5 or 8 feet.

Sealing Cable.

When necessary to cut a cable, as at the end of a run, the exposed wires should be driven back with the end of a pin or bolt and the sheath closed over same and sealed with solder. Tape should not be used for this purpose.

Tying Cable to Messenger.

Matthews' Cable Hangers should be spaced 15 inches apart; and unless cable tyer has had long experience and has accurate judgment of distances, a spacing stick should be used.

In leads of more than one cable, hangers should be spaced in perfect line abreast.

It should be the duty of the foreman in charge to inspect often and critically the work of tying cable, and to make sure that the man doing this work is dressing the cable, carefully removing kinks, curves, etc., as he goes along. Cable that presents a very untidy appearance, with numerous slack bends, crooks and flattened places, should not pass inspection. When new cable is being tied, any hangers in old cable that are untied should be replaced with Matthews' Cable Hangers and put in good shape.

Spacing of 15 inches for all sizes. (See page 23.)

Rolling Tie.

When cable is hung on No. 6 steel wire or on messenger across open gaps in block wiring, the rolling tie can be made and cable slipped along instead of being tied in ordinary style by riding messenger.



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The rolling tie should be made as follows: Clamp a rolling-tie template on messenger at proper place to do the tying. Use the ordinary clip and tie wire. Proceed as in ordinary practice, but passing the tie wire around the template. The template being of wedge shape, the tie will slip off as cable is pulled along; and the tie loop being larger than the messenger, ties will slip along without binding.

Protection of Cable.

Where cable is liable to come in contact with electric-light, trolley, or power wires or tree limbs, a guard of wooden strips put on and lashed with marline should be used. Cables should be bonded to messenger and both should be bonded to the earth.

Sealing Open Ends of Pipe Bends.

A 6-inch length of lead sleeving that will slip over the end of the pipe bend should be cut and slipped over the underground cable before junction splice is made. This short length of sleeve should be placed to project over the end of the steel pipe about 3 inches. The upper end should be dressed to the cable sheath and wiped.

Underground Laterals.

The underground cable should be carried up the pole and out on the aerial messenger a distance of 6 feet.

If the underground cable should divide in two aerial cables going in the same direction the Matthews' 3-Way Splice should be made. If the two aerial branches go in opposite directions, as may sometimes be the case, the underground cable will follow the direction that permits of the most sightly arrangement, and the cable leading in the opposite direction will back out of the Matthews' Splice.

Cable Box Grounds.

Arrester ground for cable terminal poles should be carried straight down the pole without any crooks, sharp turns or coils, and, as far as possible, without spliced points. This ground should consist of a No. 6 insulated copper wire soldered to a No. 30 gauge, 20x30 plate after the following manner: Four holes of the diameter of the No. 6 copper wire should be pierced in the copper plate, and the wire should be threaded through these. A short projecting end should be left turned back and hammered down. The wire should be carefully soldered on the alternate sides of the plate. The plate should be buried at the foot of the pole on new work before pole is set, and the wire should be carried up the pole and fastened down with staples 18 inches apart. Wire should be stretched tightly by means of a pair of slack blocks before being fastened down.

If existing pole where cable ground is to be made is set in solid rock, a hole should be drilled deep enough to receive an ordinary ground rod. The conductor should be thoroughly soldered to the rod, and then leaded into the drill hole securely to make perfect the condition between rod and rock.

The alternative of this method is to place the ordinary copper ground plate at the butt of the pole when setting the same and bedding the plate, if possible, in a matrix of clay or soil.

Do not carry the ground plate away from the pole in the endeavor to find better earth strata. A bond should be connected from this ground to cable sheath as close to the terminal of the cable as possible and be securely soldered or wiped. This bond in general can and should be attached to the extreme end of the lead sheath.

Open-space Cut Outs.

When open-space cut outs are used as a protection against lightning, double micas should not be used; and the use of emery cloth or sand paper should be strictly prohibited for cleaning carbons. The practice of rubbing carbons together to clean them should be prohibited.

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Nothing but a brush should be used in cleaning carbons. It should be remembered that the rough surface of the carbon is the vital principle of the protector, and any treatment that tends to smooth this surface lowers its efficiency.

Main Frame and Switchboard Grounds.

On storage-battery grounds the conductor should be of size specified stranded copper and the following methods of terminating same can be optional. If possible to reach water main without too long a run, the conductor should be carried in the straightest and most direct line to the selected point.

The street should be opened and the main tapped and threaded. A brass ferrule should be provided to fit this tap and soldered securely to the conductor and screwed tightly in the main. All excavation should be made at the nearest accessible point to the equipment. This excavation should be 5 feet long, 3 feet wide and 6 feet deep. The end of the conductor should be attached to a sheet of copper of specified size by piercing four holes 1 foot apart, the long way of the sheet, threading the strand through and soldering securely. A 3-inch layer of charcoal or crushed coke should be spread in the bottom of the pit, the plate placed on this layer, and an additional 3-inch layer of charcoal or coke spread over the top. The hole should then be filled and tamped in the ordinary manner. In either case the water main or coke bed should be placed as close to apparatus as possible, and all unnecessary crooks and corners should be avoided.

Dead Ending at Stations.

To prevent the wires pulling back and sagging in the horizontal spans, the wires should be secured at both ends. Each pair of wires should be twisted once around the pair of wiring rings outside the box. In all cases sufficient slack should be left between the dead end and connecting terminals in the box so that each pair of wires will be long enough to reach any terminals in the box. The necessary slack for this should be neatly arranged by looping the extra length through the wiring rings. At the entrance to the subscriber's premises the pair of wires should be fastened with a twist to one wiring ring, placed close to the point of entrance. Sufficient length should be left for the wires after forming a drip loop to reach the connecting block or protector on which the inside wiring is to terminate.

Party Line Taps.

For economy in wiring, taps should be made where possible at those points of the run from which the distance to the point of entrance to the party line subscribers will be the shortest. The tap should be twisted once around on the proper wiring ring of the run and the ends bared and connected to the party circuit by means of test connectors. The two connections should be staggered six (6) inches and at least six (6) inches from the nearest ring or knob.

Aerial Drops From Ring Wiring.

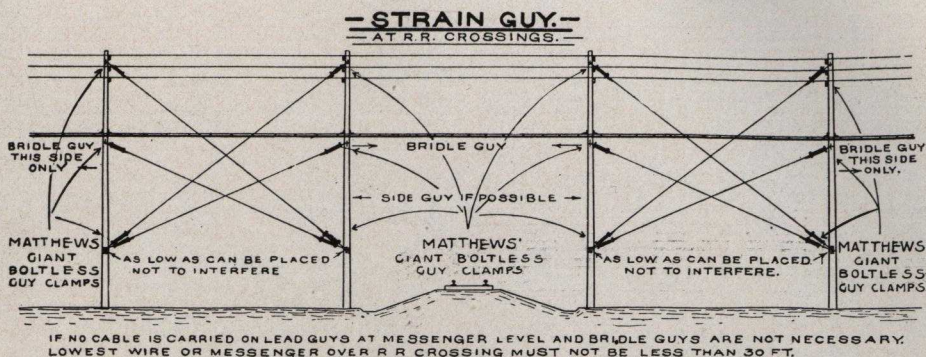
Occasionally it is convenient to reach a detached building by an aerial drop extending from the ring wiring on an adjacent building. In such cases a No. 4 knob should be attached in the usual manner to the main building at the proper height and the ring wiring should extend to the knob, the drop being fastened to the knob in the usual manner. In case the drop is less than forty (40) feet long, No. 18 bridle wire can be used, but if longer, No. 14 twisted pair wire should be used and connected to the No. 18 bridle wire in the rings.

From Pole to Building.

In cases where six (6) or more wires are to be run from a pole to a building, the same method should be employed as is used in spanning over spaces. Care should be taken to fasten the wires at the pole to prevent them sagging in the span, and sufficient ends should be allowed to connect the pairs to proper terminals in the box.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



- GRADING A POLE LINE.-

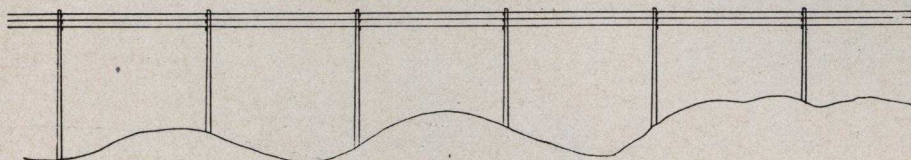


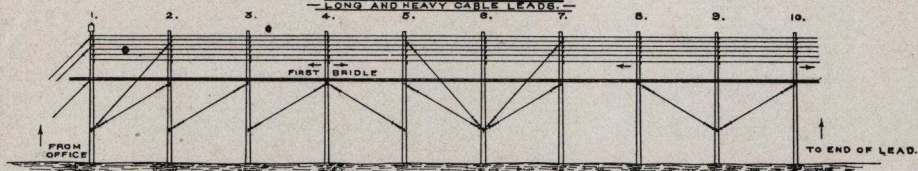
DIAGRAM 1

THIS MARK IN TRADE



MEANS HIGHEST GRADE

- STORM GUYING.-
- LONG AND HEAVY CABLE LEADS.-



FOR OPEN LINES GUY AS SHOWN, ON 5-7, 11-13, 17-19, 23-25, 29-31, 35-37, 41-43 ETC.
FOR 1 OR 2 MESSENGERS GUY AGAINST MESSENGER ON SAME POLES. OMIT GUYS ON 3-4.
FOR 4 MESSENGERS OR MORE PUT ADDITIONAL GUY AGAINST MESSENGER ON 8-10, 14-16, 20-22, 26-28, 32-34, 38-40, 44-46 ETC. USING BRIDGE GUY ON EVEN POLES IN DIRECTION THE ARROW POINTS AND OMITTING ON ODD POLES.
IN CASE A LEAD CARRIES SAME NUMBER OF MESSENGERS FROM ANCHOR TO ANCHOR, TREAT TAIL OF LEAD AS ON 1-2-3-4 MATTHEWS' GIANT BOLTLESS GUY CLAMPS SHOULD BE USED ON THIS GUYING.

- BRIDGE GUYS.-
- STORM GUYED CABLE LEADS AS ON POLES 8-10 ETC.-

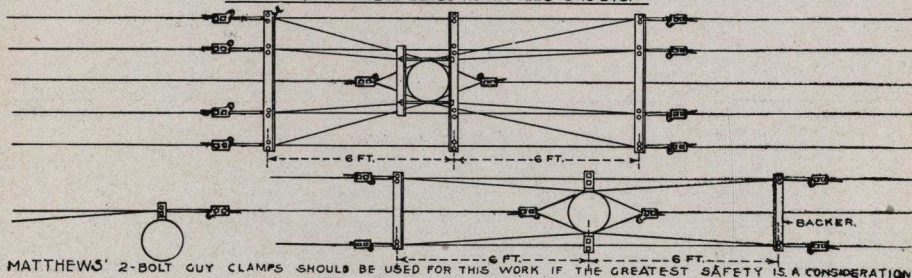
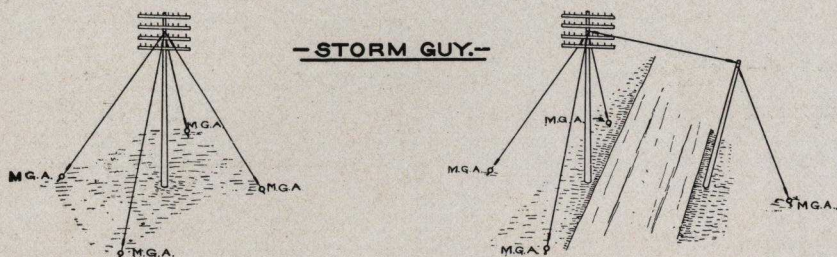
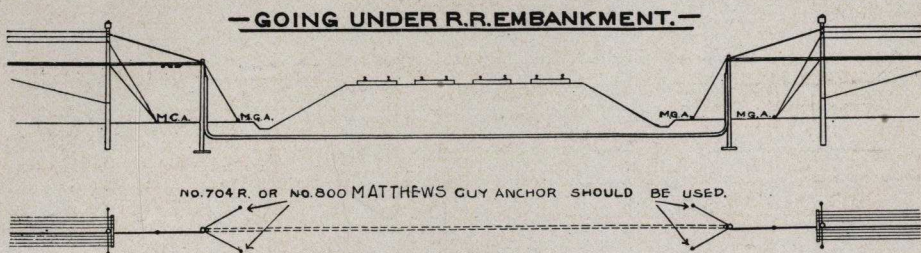


DIAGRAM 2



No. 502R or No. 603R Matthews Guy Anchor should be used. See page 56 for result.

DIAGRAM 3

THIS MARK IN TRADE



MEANS HIGHEST GRADE

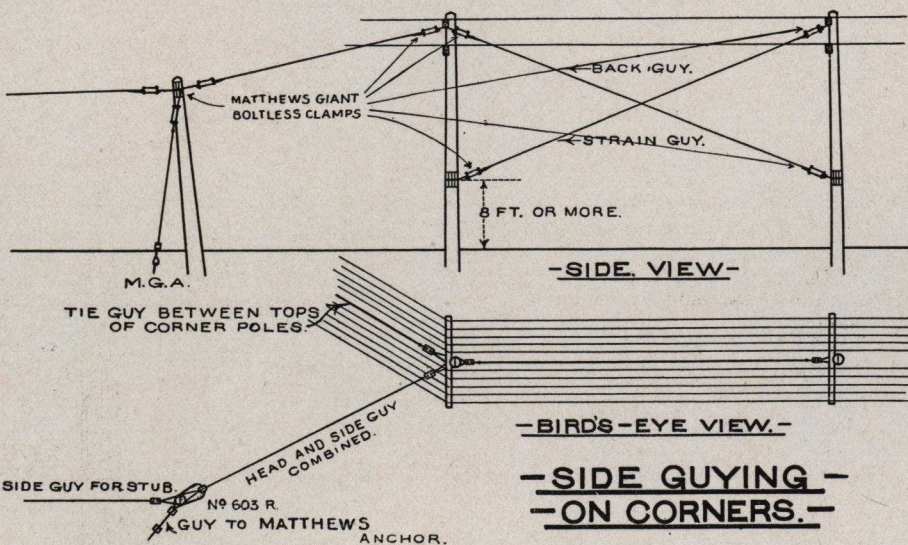


DIAGRAM 4

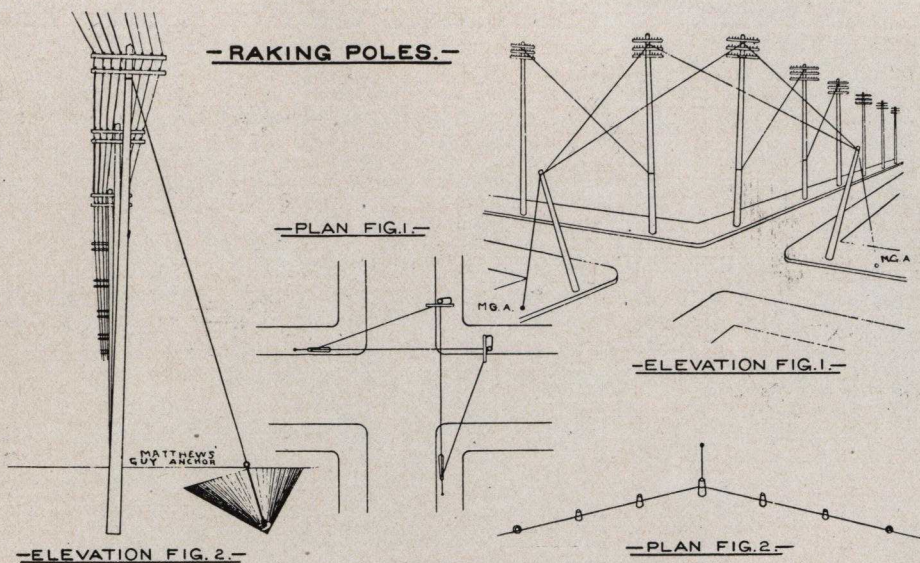


DIAGRAM 5

THIS MARK IN TRADE



MEANS HIGHEST GRADE

Fig. 1 and Fig. 2 shows the method of increasing the anchorage with Matthews Guy Anchor when increased strains are added.

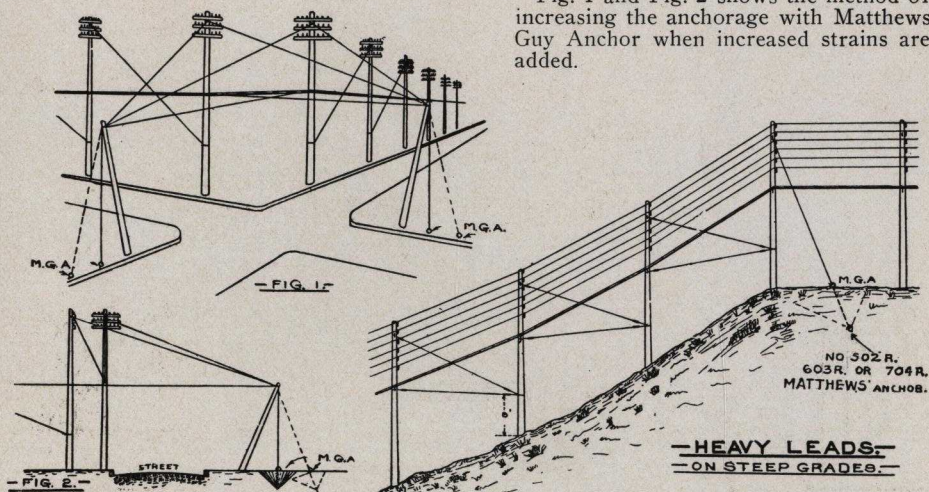
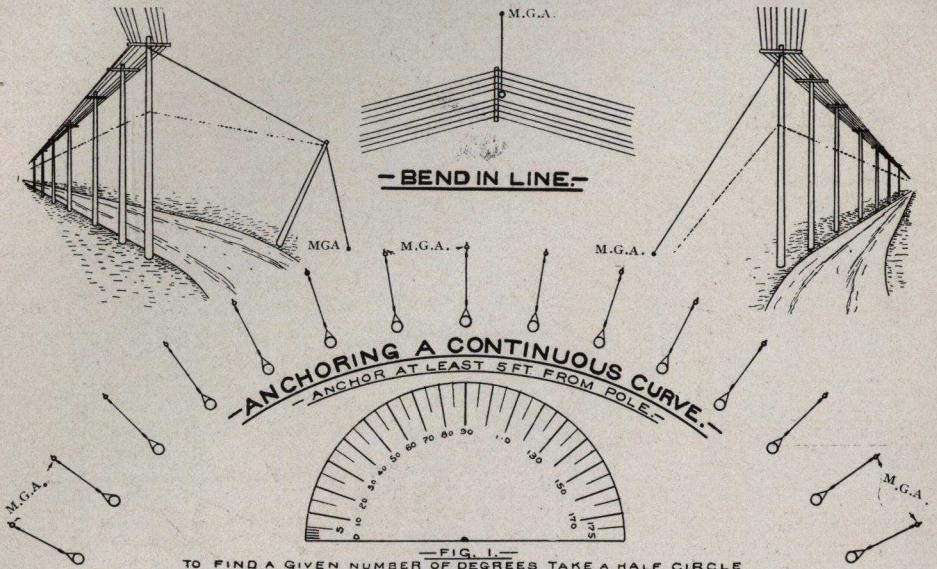


DIAGRAM 6



Use No. 502R Matthews Guy Anchors for all cases shown above.

DIAGRAM 7

THIS MARK IN TRADE



MEANS HIGHEST GRADE

-FACING ARMS AT HEAD AND TAIL OF LEAD.-

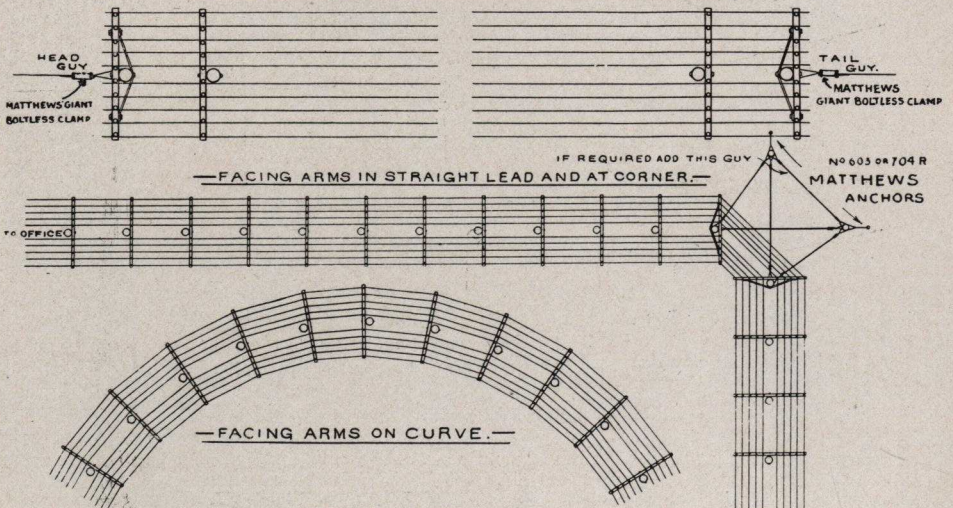


DIAGRAM 8

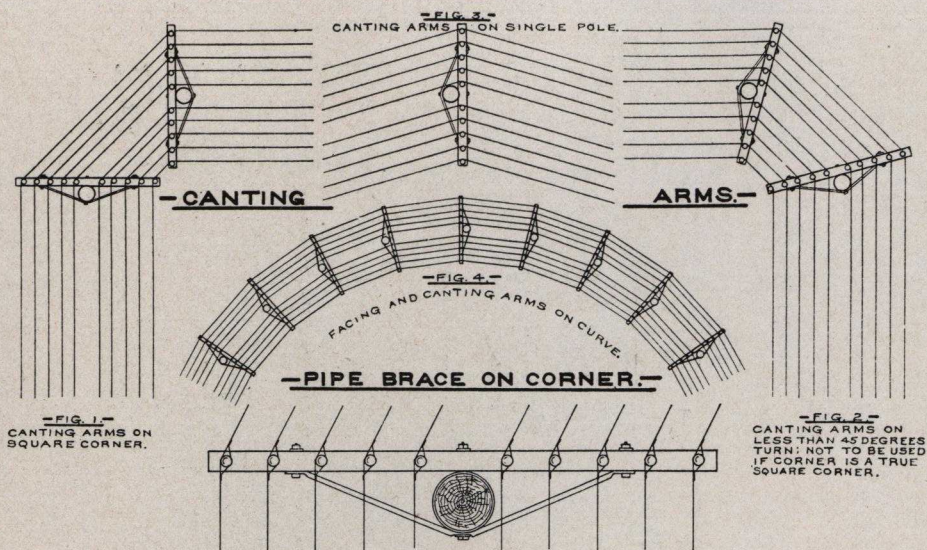


DIAGRAM 9

THIS MARK IN TRADE



MEANS HIGHEST GRADE

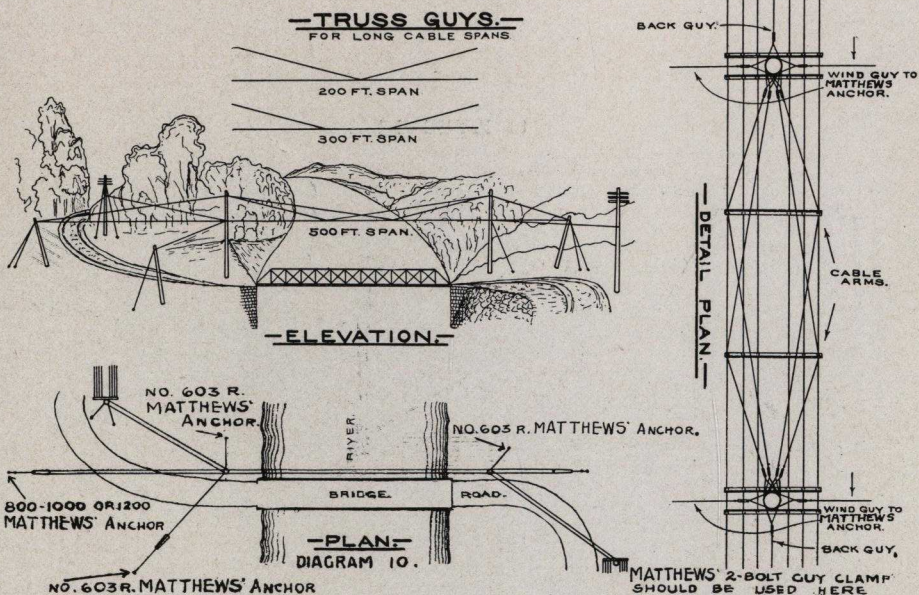


DIAGRAM 10

ROAD CROSSING
WHEN POSSIBLE TO USE SIDE AND HEAD GUYS

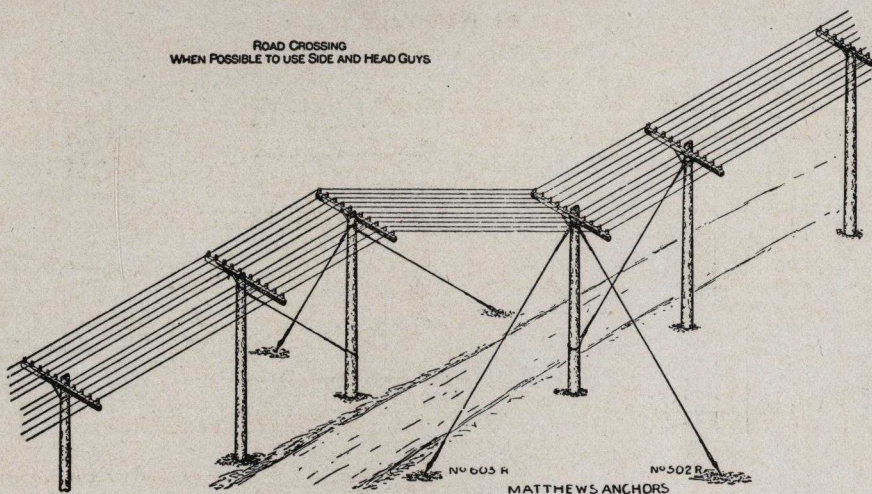


DIAGRAM 11

THIS MARK IN TRADE



MEANS HIGHEST GRADE

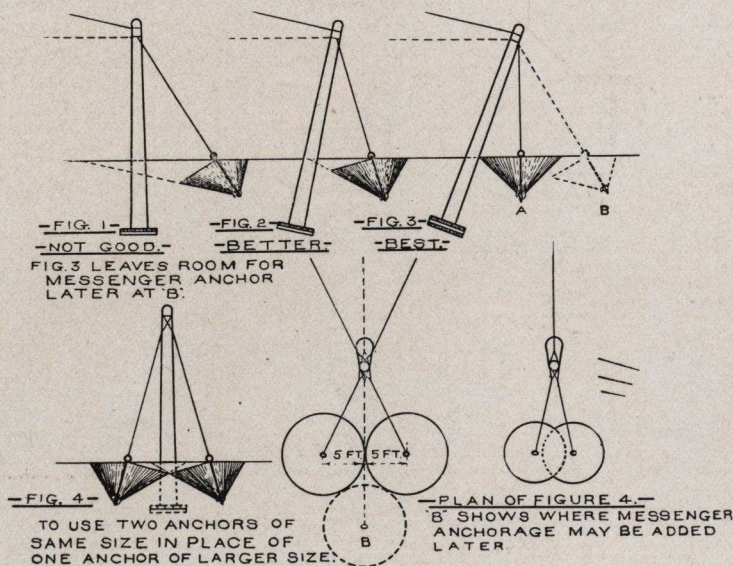
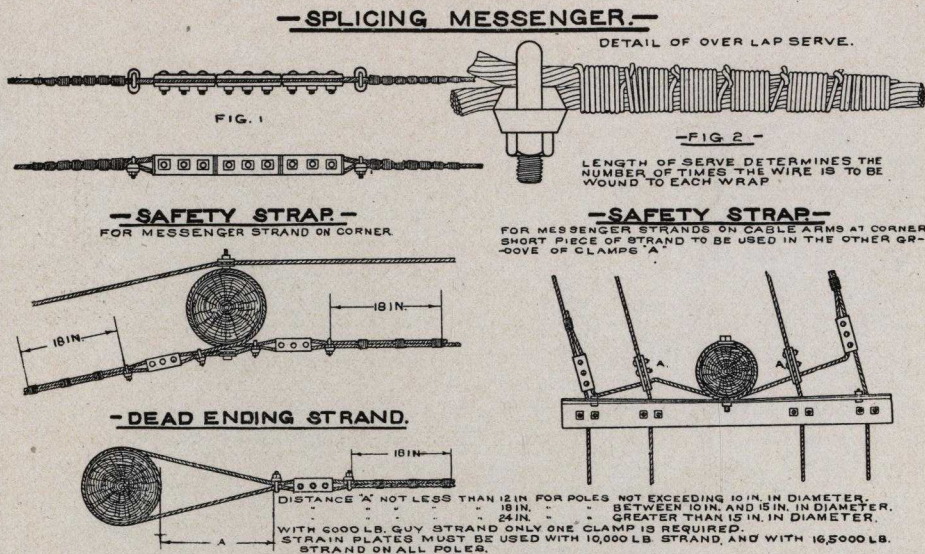
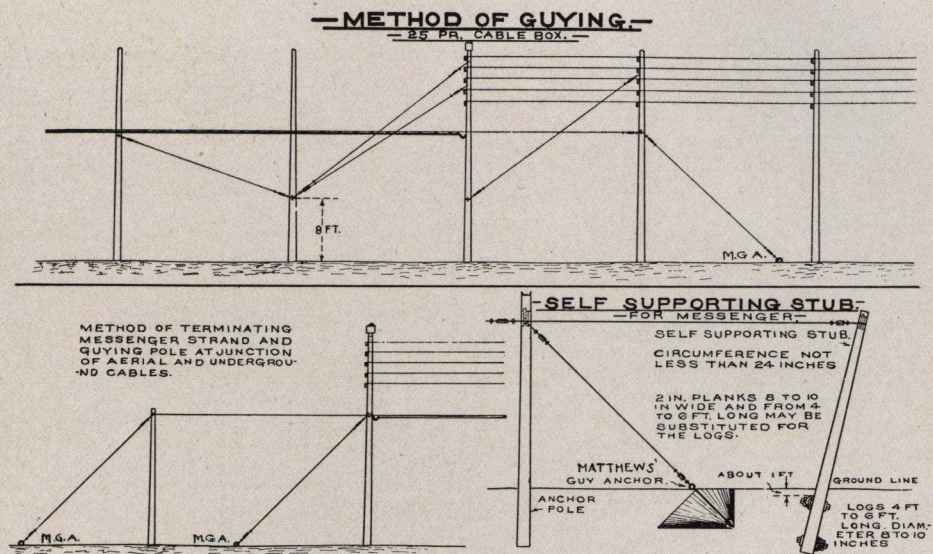
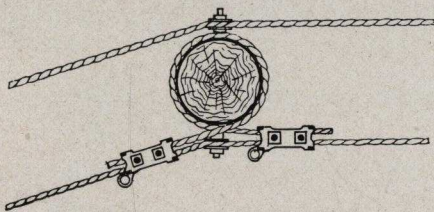


DIAGRAM 12

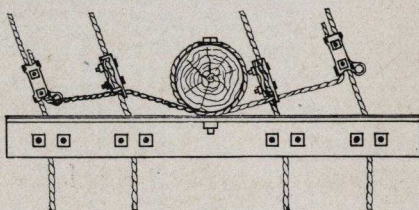


See next page for a better way.

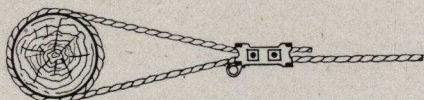
SHOWING ECONOMY OF USING MATTHEWS 2-BOLT GUY CLAMP



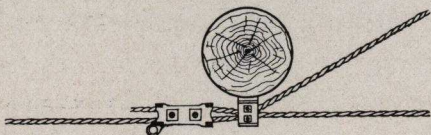
See page 163 for comparison.



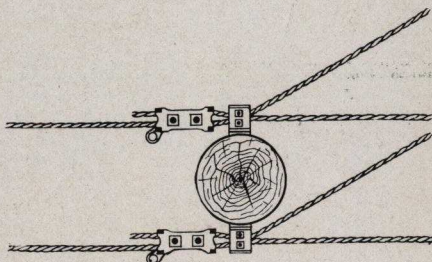
See page 163 for comparison.



See page 163 for comparison.



DETAIL OF FIG. 1.



DETAIL OF FIG. 2.

See comparisons below.

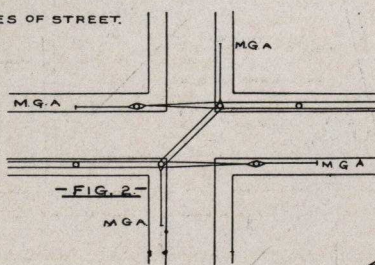
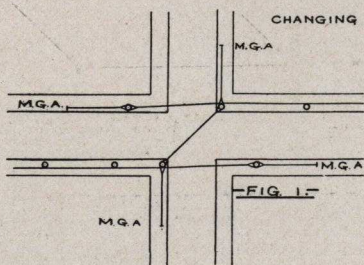
DIAGRAM 15

THIS MARK IN TRADE

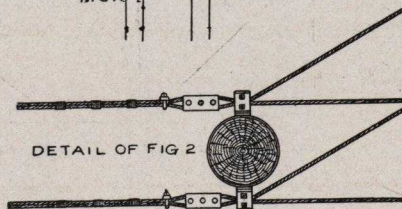


MEANS HIGHEST GRADE

-AERIAL MESSENGER-



DETAIL OF FIG. 1



DETAIL OF FIG. 2

DIAGRAM 16

Method of Splicing Strands



Splice for 6000-6000 or 6000-10000 pound strand

FIG- I



Splice for 10000-10000 or 10000-16500 pound strand

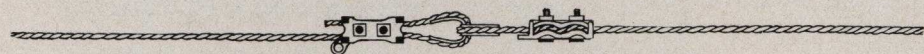
FIG II



Splice for 16500-16500 pound strand

FIG III

SHOWING ECONOMY OF USING MATTHEWS 2-BOLT CLAMP



SPLICE FOR 6000-6000 OR 10000-16500 POUND STRAND
OR 16500-16500 POUND STRAND

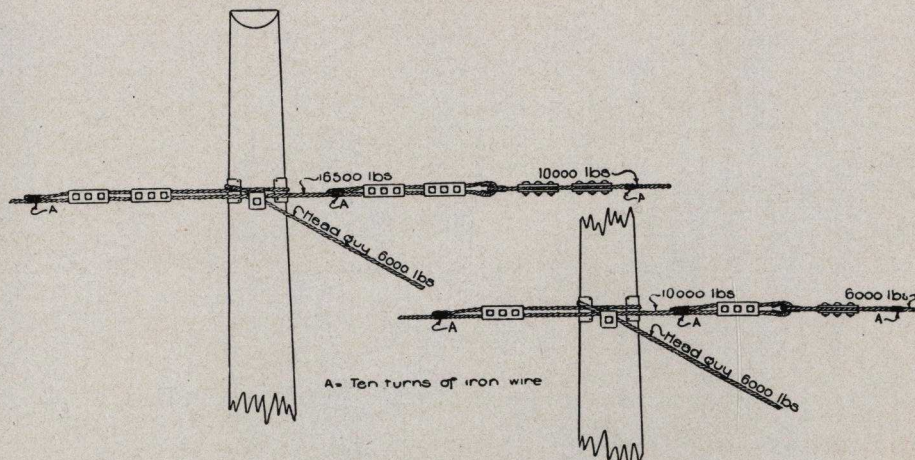
DIAGRAM 17

THIS MARK IN TRADE



MEANS HIGHEST GRADE

Method of Tapering Messenger Strands



See next page for a better way.

DIAGRAM 18

SHOWING THE ECONOMY OF USING MATTHEWS 2-BOLT GUY CLAMPS

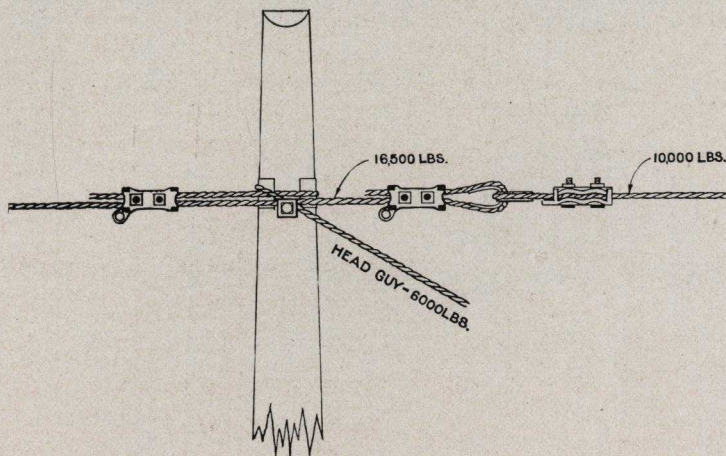


DIAGRAM 19

See comparison on page 165.

166

THIS MARK IN TRADE



MEANS HIGHEST GRADE

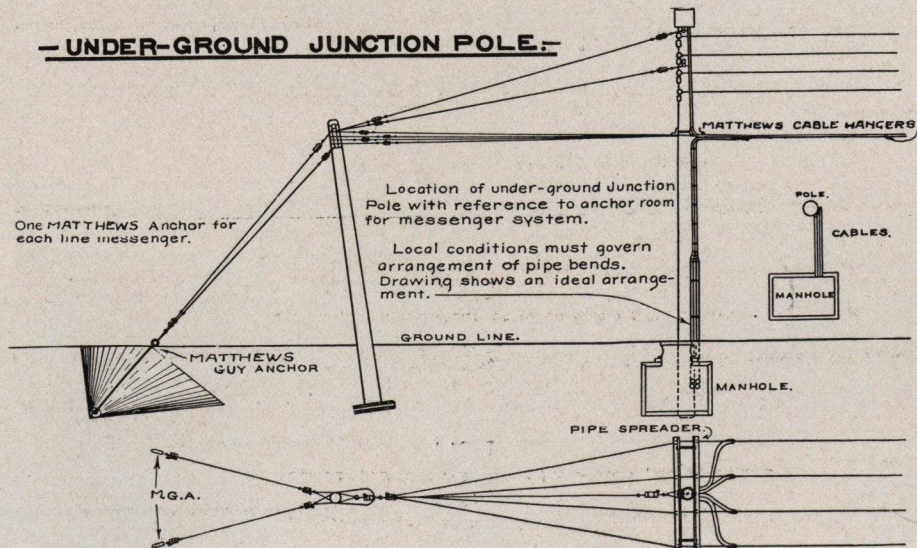


DIAGRAM 20

-HANGING BLOCKS.-

HANDLING HEAVY BLOCKS ON
GROUND INSTEAD OF ON POLE.

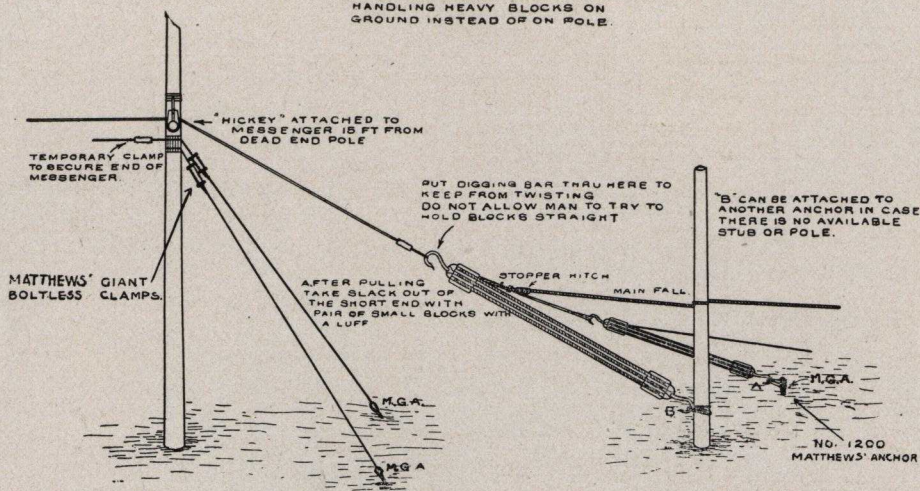


DIAGRAM 21

THIS MARK IN TRADE



MEANS HIGHEST GRADE

-FEEDING OFF CABLE.-

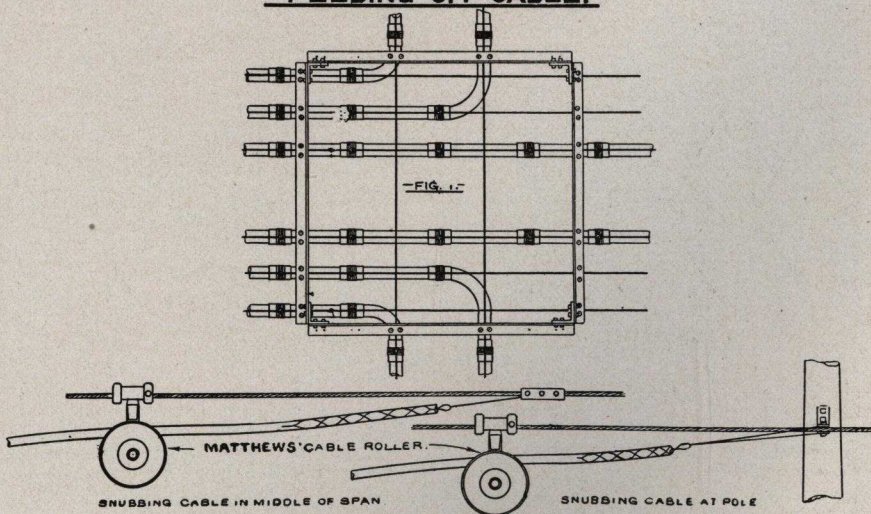
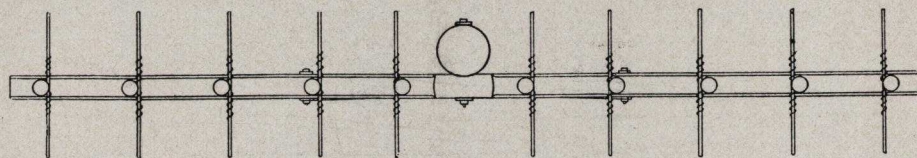
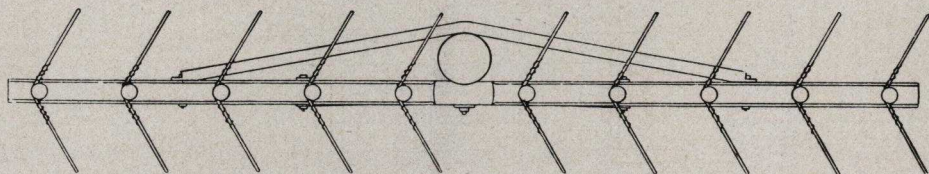


DIAGRAM 22

Location of Wires On Cross Arms



Straight Line



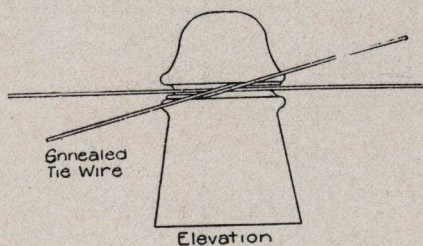
Curve or Corner

DIAGRAM 23

THIS MARK IN TRADE



MEANS HIGHEST GRADE



Method of Tying Wire

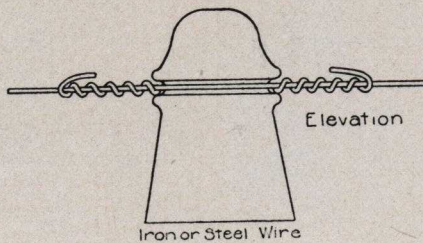
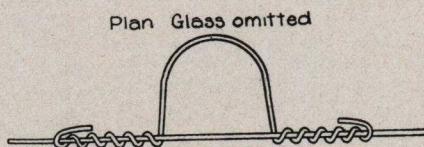
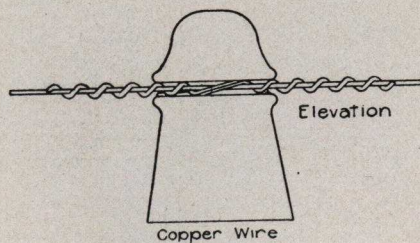


DIAGRAM 24

PARALLELOGRAM OF FORCES

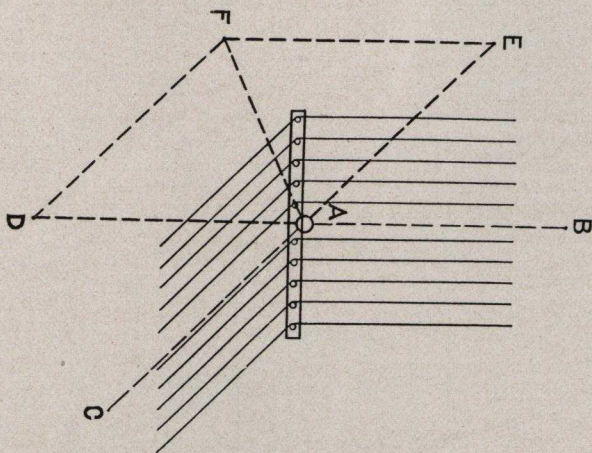


DIAGRAM 25

In drawing Parallelogram, make line AE of equal length with line AC, and line AD of equal length with line AB. Draw line FE parallel with line AD, and line DF parallel with line AE. If length of lines AB and AC represent the total tensions in these two spans, then the length of line AF will represent the resultant of all the tensions in such a corner pole. A single guy to hold such a corner must be set along line AF.

THIS MARK IN TRADE



MEANS HIGHEST GRADE

POLYGON OF FORCES

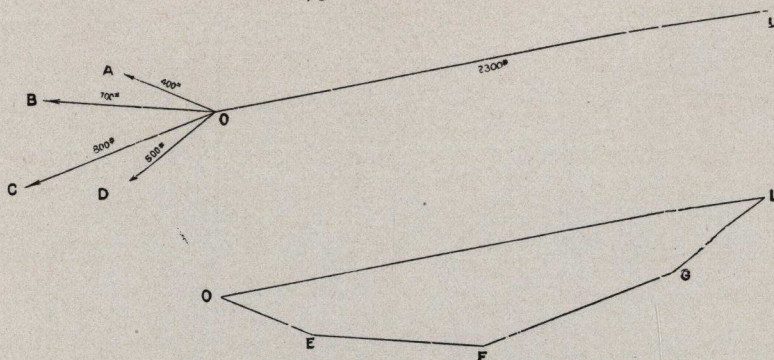
$$\frac{1}{8}\text{-inch}=100 \text{ lbs.}$$


DIAGRAM 26

To find resultant OL of forces AO, BO, CO and DO, lay out these forces to any convenient scale of pounds as shown in upper figure. Then draw the Polygon shown in lower figure, making the side OE parallel to and of the same length as AO, EF same as BO, FG same as CO, and GL same as DO. Then by connecting the points O and L, the length of this line will equal the resultant of all forces, and its direction should be the direction in which a guy OL should be placed.

STRAIN IN GUYS AND COMPRESSION IN POLES

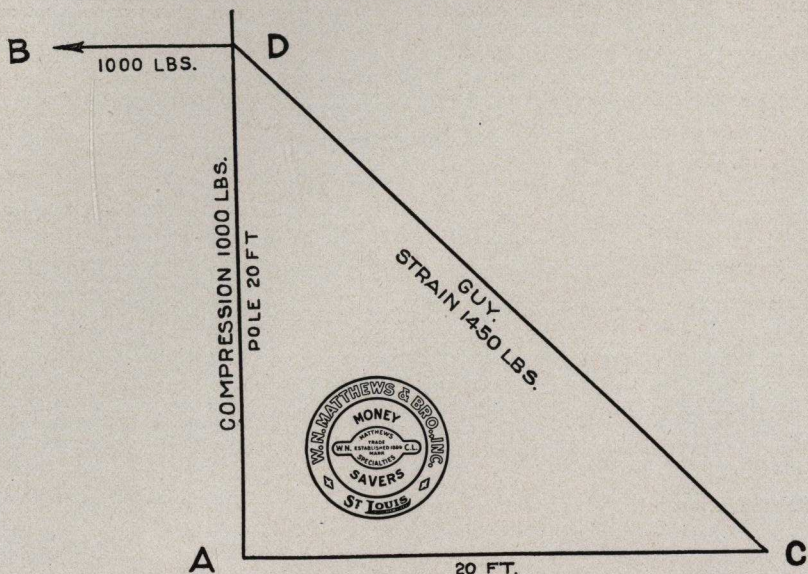


DIAGRAM 27

To any convenient scale of pounds, draw line AC, making it equal in length to the resultant of all forces at top of pole (BD). From A erect the perpendicular AD, making it in length in proportion and on the same scale as the line AC. Then the length of line AD, measured to the same scale of pounds as AC gives the compression in the pole, and the length of line DC equals the strain in the Guy. Abbott's Telephony, Vol. 4, page 71.

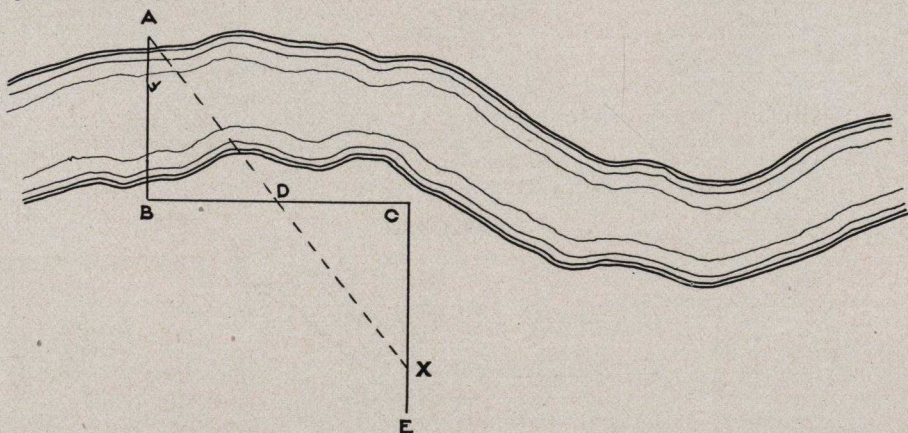


DIAGRAM 28

TO FIND WIDTH OF RIVER WITHOUT USE OF INSTRUMENTS

The length of line AB being the width desired, lay out BC at right angles to the line AB and another line CE parallel to line AB. Dissect line BC and sight from A through D to the point X on line CE. The length CX will equal the length AB.

If there is not sufficient space to lay out line, the full width of river, line BC may be bisected at a point near C. Then upon sighting from A through D, the following equation will obtain:

$$AB : CX :: BD : DC$$

$$\text{and } AB = \frac{CX \times BD}{DC}$$

RESISTANCE OF SOILS

Firm sand, gravel or loam, 4 tons per square foot. Damp sand, moist loam, or loose gravel, 2 tons per square foot. No data for marsh.

USEFUL DATA

DECIMAL EQUIVALENTS

Of eighths, sixteenths, thirty-seconds and sixty-fourths of an inch.

Fractions of an Inch.	Decimals of an Inch.	M. M.	Fractions of an Inch.	Decimals of an Inch.	M. M.	Fractions of an Inch.	Decimals of an Inch.	M. M.	Fractions of an Inch.	Decimals of an Inch.	M. M.
1/64 = .015625		.397	17/64 = .265625		6.75	33/64 = .515625		13.1	49/64 = .765625		19.45
1/32 = .03125		.79	9/32 = .28125		7.14	17/32 = .53125		13.49	25/32 = .78125		19.84
3/64 = .046875		1.19	19/64 = .296875		7.54	35/64 = .546875		13.89	51/64 = .796875		20.24
1/16 = .0625		1.59	5/16 = .3125		7.94	9/16 = .5625		14.29	13/16 = .8125		20.64
5/64 = .078125		1.98	21/64 = .328125		8.33	37/64 = .578125		14.68	53/64 = .828125		21.03
3/32 = .09375		2.38	11/32 = .34375		8.73	19/32 = .59375		15.08	27/32 = .84375		21.43
7/64 = .109375		2.77	23/64 = .359375		9.13	39/64 = .609375		15.48	55/64 = .859375		21.83
1/8 = .125		3.17	3/8 = .375		9.52	5/8 = .625		15.87	7/8 = .875		22.22
9/64 = .140625		3.57	25/64 = .390625		9.92	41/64 = .640625		16.27	57/64 = .890625		22.62
5/32 = .15625		3.97	13/32 = .40625		10.32	21/32 = .65625		16.7	29/32 = .90625		23.02
11/64 = .171875		4.37	27/64 = .421875		10.72	43/64 = .671875		17.06	59/64 = .921875		23.41
3/16 = .1875		4.76	7/16 = .4375		11.11	11/16 = .6875		17.46	15/16 = .9375		23.81
13/64 = .203125		5.16	29/64 = .453125		11.51	45/64 = .703125		17.86	61/64 = .953125		24.21
7/32 = .21875		5.56	15/32 = .46875		11.91	23/32 = .71875		18.26	31/32 = .96875		24.61
15/64 = .234375		5.95	31/64 = .484375		12.30	47/64 = .734375		18.65	63/64 = .984375		25.
1/4 = .25		6.35	1/2 = .5		12.7	3/4 = .75		19.05	1 = 1		25.4

FEET EXPRESSED IN DECIMAL PARTS OF A MILE

	Units	Tens	Hundreds	Thousands
1	.000189	.001893	.01893	.1893
2	.000378	.003787	.03787	.3787
3	.000568	.005681	.05681	.5681
4	.000757	.007574	.07574	.7574
5	.000946	.009468	.09468	.9468
6	.001136	.011362	.11362	
7	.001325	.013255	.13255	
8	.001514	.015148	.15148	
9	.001704	.017042	.17042	

GENERAL EQUIVALENTS

CM = Circular mils.
 SqM = Square mils.
 1 CM = .7854 SqM.
 1 SqM = 1.2732 CM.
 1 Sq. in. = 1,000,000 SqM.

1 Sq. in. = 1,273,200 CM.
 1 Sq. in. = area of a circle 1.128" diam.
 Area of a circle 1" diam. = 1,000,000 CM.
 Area of a circle 1" diam. = 785,400 SqM.

TABLE OF MULTIPLES

Diameter of a circle $\times$ 3.1416 = Circumference.
 Radius of a circle $\times$ 6.283185 = Circumference.
 Square of the radius of a circle $\times$ 3.1416 = Area.
 Square of the diameter of a circle $\times$ 0.7854 = Area.
 Square of the circumference of a circle $\times$ 0.07958 = Area.
 Half the circumference of a circle $\times$ by half its diameter = Area.
 Circumference of a circle $\times$ 0.159155 = Radius.
 Square root of the area of a circle $\times$ 0.56419 = Radius.
 Circumference of a circle $\times$ 0.31831 = Diameter.
 Square root of the area of a circle $\times$ 1.12838 = Diameter.
 Diameter of a circle $\times$ 0.86 = Side of inscribed equilateral triangle.
 Diameter of a circle $\times$ 0.7071 = Side of an inscribed square.
 Circumference of a circle $\times$ 0.225 = Side of an inscribed square.
 Circumference of a circle $\times$ 0.282 = Side of an equal square.
 Diameter of a circle $\times$ 0.8862 = Side of an equal square.
 Base of a triangle $\times$ by $\frac{1}{2}$ the altitude = Area.
 Multiplying both diameters and .7854 together = Area of an ellipse.
 Surface of a sphere $\times$ by $\frac{1}{6}$ of its diameter = Solidity.
 Circumference of a sphere $\times$ by its diameter = Surface.

Square of the diameter of a sphere $\times$ 3.1416 = Surface.
 Square of the circumference of a sphere $\times$ 0.3183 = Surface.
 Cube of the diameter of a sphere $\times$ 0.5236 = Solidity.
 Cube of the radius of a sphere $\times$ 4.1888 = Solidity.
 Cube of the circumference of a sphere $\times$ 0.016887 = Solidity.
 Square root of the surface of a sphere $\times$ 0.56419 = Diameter.
 Square root of the surface of a sphere $\times$ 1.772454 = Circumference.
 Cube root of the solidity of a sphere $\times$ 1.2407 = Diameter.
 Cube root of the solidity of a sphere $\times$ 3.8978 = Circumference.
 Radius of a sphere $\times$ 1.1547 = Side of inscribed cube.
 Square root of $(\frac{1}{3}$ of the square of) the diameter of a sphere = Side of inscribed cube.
 Area of its base $\times$ by $\frac{1}{3}$ of its altitude = Solidity of a cone or pyramid, whether round, square or triangular.
 Area of one of its sides $\times$ 6 = the surface of a cube.
 Altitude of trapezoid $\times$ $\frac{1}{2}$ the sum of its parallel sides = Area.

THE METRIC SYSTEM

MEASURES OF LENGTH

Myriameter	= 10,000 meters = 6.2137 miles.	Meter	= 1 meter = 39.37 inches.
Kilometer	= 1,000 meters = 0.62137 m. or 3,280 ft. 10 in.	Decimeter	= .1 of a meter = 3.937 inches.
Hectometer	= 100 meters = 328 ft. and 1 inch.	Centimeter	= .01 of a meter = 0.3937 inch.
Dekameter	= 10 meters = 39.37 inches.	Millimeter	= .001 of a meter = 0.0394 inch.

MEASURES OF SURFACE.

Hectare	= 10,000 sq. meters = 2.471 acres.	Centare	= 1 square meter = 1,550 square inches.
Are	= 100 sq. meters = 119.6 sq. yards.		

MEASURES OF CAPACITY

Name.	No. Liters.	Cubic Measure.	Dry Measure.	Name.	No. Liters.	Cubic Measure.	Wine Measure
Kiloliter	= 1,000	= 1 cubic meter	= 1.308 cu. yds.	Kiloliter	= 1,000	= 1 cubic meter	= 264.17 gals.
Hectoliter	= 100	= .1 cubic meter	= 2 bu. 3.35 pks.	Hectoliter	= 100	= .1 cubic meter	= 26.417 gals.
Decaliter	= 10	= 10 cu. decimeters	= 9.08 quarts.	Decaliter	= 10	= 10 cu. decimeters	= 2.6417 gals.
Liter	= 1	= 1 cu. decimeter	= 0.908 quart.	Liter	= 1	= 1 cu. decimeter	= 1.0567 quarts.
Deciliter	= .1	= 1 cu. decimeter	= 6.1022 cu. ins.	Deciliter	= .1	= 1 cu. decimeter	= 0.845 gill.
Centiliter	= .01	= 10 cu. centimeters	= 0.6102 cu. in.	Centiliter	= .01	= 10 cu. centimeters	= 0.388 fluid oz.
Milliliter	= .001	= 1 cu. centimeter	= 0.061 cu. in.	Milliliter	= .001	= 1 cu. centimeter	= 0.27 fluid oz.

WEIGHTS

Metrie Denominations and Values.	No. Grams.	Equivalents in Denominations in Use.	Name.	No. Grams.	Avoirdupois Weight.
Millier or tonneau	= 1,000,000	= 1 cubic meter.	Millier or tonneau	= 1,000,000	= 2,204.6 pounds.
Quintal	= 100,000	= 1 hectoliter.	Quintal	= 100,000	= 220.46 pounds.
Myriagram	= 10,000	= 10 liters.	Myriagram	= 10,000	= 22.046 pounds.
Kilogram or Kilo	= 1,000	= 1 liter.	Kilogram or Kilo	= 1,000	= 2.2046 pounds.
Hectogram	= 100	= 1 deciliter.	Hectogram	= 100	= 3.5274 ounces.
Dekagram	= 10	= 10 cubic centimeters.	Dekagram	= 10	= 0.3527 ounce.
Gram	= 1	= 1 cubic centimeter.	Gram	= 1	= 15.432 grains.
Decigram	= .1	= 1 cubic centimeter.	Decigram	= .1	= 1.5432 grains.
Centigram	= .01	= 10 cubic millimeters.	Centigram	= .01	= 0.1543 grain.
Milligram	= .001	= 1 cubic millimeter.	Milligram	= .001	= 0.0154 grain.

Unit. Equivalent Value in Other Units.

1 H. P.	= { 746 watts. 746 K. W. 33,000 ft.-lbs. per minute. 550 ft.-lbs. per second. 2,545 heat-units per hour. 42.4 heat-units per minute. .707 heat-unit per second. .175 lb. carbon oxidized per hour. 2.64 lbs. water evaporated per hour from and at 212° F.
1 H. P. Hour	= { 746 K. W. hours. 1,980,000 ft.-lbs. 2,545 heat-units. 273,740 k. g. m. .175 lb. carbon oxidized with perfect efficiency. 2.64 lbs. water evaporated from and at 212° F. 17.0 lbs. water raised from 62° to 212° F.
1 Kilo-watt	= { 1,000 watts. 1.34 H. P. 2,654,200 ft.-lbs. per hour. 44,240 ft.-lbs. per minute. 737.3 ft.-lbs. per second. 3,412 heat-units per hour. 56.9 heat-units per minute. .948 heat-unit per second. 227.5 lb. carbon oxidized per hour. 3.53 lbs. water evaporated per hour from and at 212° F.
1 Watt per sq. in.	= { 8.19 heat-units per sq. ft. per minute. 6371 ft.-lbs. per sq. ft. per minute. .193 H. P. per sq. ft.
1 Kilogram Metre	= { 7,233 ft.-lbs. .00000365 H. P. hour. .00000272 K. W. hour. .0093 heat-units.
1 lb. Water Evapo-rated from and at 212° F.	= { .283 K. W. hour. .379 H. P. hour. 965.7 heat-units. 103,900 k. g. m. 1,019,000 joules. 761,300 ft.-lbs. .0004 lb. of carbon oxidized.

Unit. Equivalent Value in Other Units.

1 Heat-unit	= { 1,055 watt seconds. 778 ft.-lbs. 107.6 kilogram metres. .000293 K. W. hour. .000393 H. P. hour. .0000688 lb. carbon oxidized. .001036 lbs. water evaporated from and at 212° F.
1 Heat-unit per sq. ft. per min.	= { .122 watts per sq. in. .0176 K. W. per sq. ft. .0236 H. P. per sq. ft.
1 Watt	= { 1 joule per second. .00134 H. P. 3,412 heat-units per hour. .7373 ft.-lb. per second. .0035 lb. water evaporated per hour. 44.24 ft.-lbs. per minute.
1 K. W. Hour	= { 1,000 watt hours. 1.34 H. P. hours. 2,654,200 ft.-lbs. 3,600,000 joules. 3,412 heat-units. 367,000 kilogram metres. .235 lb. carbon oxidized with perfect efficiency. 3.53 lbs. water evaporated from and at 212° F. 22.75 lbs. of water raised from 62° to 212° F.
1 Joule	= { 1 watt second. .000000278 K. W. hour. .102 k. g. m. .0009477 heat-units. .7373 ft.-lb.
1 ft.-lb.	= { 1.356 joules. 1.383 k. g. m. .000000377 K. W. hours. .001255 heat-units. .0000005 H. P. hour.
1 lb. Carbon Oxidized with Perfect Efficiency	= { 14,544 heat-units. 1.11 lb. anthracite coal oxidized 2.5 lbs. dry wood oxidized. 21 cubic ft. illuminating gas. 4.26 K. W. hours. 5.71 H. P. hours. 11,315,000 ft.-lbs. 15 lbs. of water evaporated from and at 212° F.

USEFUL DATA

DEFINITIONS OF ELECTRICAL UNITS

All electrical units are derived from the following mechanical units:

The Centimeter is the unit of length, and equals .3937 inch, or .000000001 of a quadrant of the earth.

The Gram is the unit of mass, and is equal to 15.432 grains, the mass of a cubic centimeter of water at 4° C.

The Second is the unit of time and is the time of one swing of a pendulum, swinging 86464.09 times per day, or the 1-86400th part of a mean solar day.

The Volt is the unit of electro-motive force [E].

Electro-motive Force, which is the force that moves electricity, is usually written E. M. F. (in formulae E) and various writers use it to express potential difference of potential, electric pressure and electric force. One volt will force an ampere of current through one ohm of resistance. Its value is purely arbitrary, but fixed.

The Ohm is the unit of resistance [R], and it is equal to the resistance of a column of pure mercury 1 square millimeter in section and 106 centimeters long at the temperature of melting ice. One ohm is that resistance through which one ampere of current will flow at a pressure of one volt of E. M. F.

The Megohm = 1,000,000 ohms.

The Ampere is the unit of current strength [C]. Its value may be defined as that quantity of electricity which flows through one ohm of resistance when impelled by one volt of E. M. F. One ampere of current flowing through a bath will deposit 0.017253 grain of silver or 0.005085 grain of copper per second.

The Coulomb is the unit of quantity [Q], and is the quantity of electricity passing per second when the current is one ampere.

The Farad is the unit of capacity [K], and is that capacity that will contain one coulomb at a potential of one volt. A condenser of one farad capacity, if charged to two volts, will contain two coulombs; if to 100 volts, 100 coulombs, etc.

The Microfarad [mfd] = one-millionth of a farad.

The Joule is the unit of work [W]. It is the work done or heat generated by a watt in a second. It is equal to .7373 foot-pound.

The Watt is the unit of electrical power [P], and is the energy contained in a current of one ampere with an electro-motive force of one volt. 746 watts = one horse power. A current of 10 amperes and 74.6 volts will do the work of one horse power.

A Horse Power in a steam engine or other prime mover is 550 lbs. raised one foot per second, or 33,000 lbs. one foot per minute.

A Kilowatt [kw] equals 1,000 watts. The E. M. F. is distributed according to the resistance of the various parts of the circuit, except where there is counter E. M. F.

Counter E. M. F. is like back pressure in hydraulics. Thus, to find the available E. M. F., or the resulting current against a resistance where there is a counter E. M. F., the counter E. M. F. must be deducted. For example: Suppose a storage battery with a resistance of .02 ohm and a C. E. M. F. of 15 volts, and you wish to charge it with a dynamo which gives an E. M. F. of 20 volts at the battery binding posts. There are $20 - 15 = 5$ volts working through a resistance of .02 of an ohm with consequently a current of 250 amperes. The fall of potential is, however, virtually 20 volts, and not 5 volts, and the power is $20 \times 250 = 5000$ watts, and not $5 \times 250 = 1250$ watts, as might perhaps be supposed. It is obvious that the C. E. M. F. has acted as a true resistance. In the above case $5 \times 250 = 1250$ watts were wasted in overcoming the resistance of the storage battery and the remaining 3750 watts were stored up in the chemical changes which they brought about in the active material of the storage battery

Mils. = Thousandths of an inch. d^2 = circular mils.

The Circular Mil. is now generally used as the unit of area when considering the cross-section of electric conductors, the resistance being inversely, and weight of copper directly proportional to the circular mils.

USEFUL DATA
ELECTRICAL UNITS AND MECHANICAL EQUIVALENTS.
ALTERNATING CURRENT.

At Voltage of	1000	2000	3000	4000	5000	
1 Horse Power =	3/5	3/10	1/5	3/20	1/8	Ampere.
1 Ampere =	2/3	3 1/3	5	6	8 1/3	Horse Power.
1 Horse Power =		11 1/2	11	10 1/2	10	16 C. P. Lamps.
1 Ampere =		40	60	80	100	16 C. P. Lamps.

AMPERES PER HORSE POWER.

The following table shows number of amperes required per horse power when the percentage of efficiency of the motor is known:

Efficiency of Motor	75 per cent.	80 per cent.	85 per cent.	90 per cent.
At 110 Volts.....	9 Amp.	8.4 Amp.	7.9 Amp.	7.5 Amp.
At 220 Volts.....	4.5 Amp.	4.2 Amp.	3.95 Amp.	3.75 Amp.
At 500 Volts.....	1.98 Amp.	1.86 Amp.	1.75 Amp.	1.66 Amp.

AMPERES PER GENERATOR.

K. W.	125 Vs.	250 Vs.	500 Vs.	Appx. H. P.	K. W.	125 Vs.	250 Vs.	500 Vs.	Appx. H. P.
1	8	4	2	1.3	30	240	120	60	40
2	16	8	4	2.7	37.5	300	150	75	50
3	24	12	6	4.0	40	320	160	80	53
5	40	20	10	6.7	50	400	200	100	67
7.5	60	30	15	10	60	480	240	120	80
10	80	40	20	13	75	600	300	150	100
12.5	100	50	25	17	100	800	400	200	134
15	120	60	30	20	125	1000	500	250	167
20	160	80	40	27	150	1200	600	300	201
25	200	100	50	34	200	1600	800	400	268

AMPERES PER MOTOR.

H. P.	Per Cent Eff.	Watts Input.	50 Volts	100 Volts	220 Volts	500 Volts
3/4	70	800	16	7	4	2
1 1/2	70	1600	32	15	7	3
3	75	2980	60	27	14	6
4	80	4660	93	42	21	9
7 1/2	85	6580	132	60	30	13
10	85	8780	176	80	40	18
15	85	13200	264	120	60	26
20	85	17600	352	160	80	35
25	85	21900	438	199	100	44
30	90	24900	498	226	113	50
40	90	33200	664	301	151	66
50	90	41400	828	376	188	83
60	90	49700	994	452	226	99
70	90	58000	1160	527	264	116
80	90	66300	1330	603	302	133
90	90	74600	1490	678	339	149
100	90	82900	1660	755	377	166
120	90	99500	1990	905	453	199
150	90	124000	2480	1130	564	248

C = Current in Amperes.
 HP = Horse Power.

E = Voltage.
 K = Efficiency of Motor.

$$C = \frac{HP \times 74600}{E \times K}$$

USEFUL DATA

ALTERNATING CURRENT FORMULA

$$1 = \frac{W}{E \times \text{P.F.}} \text{ for single-phase circuit.} \quad 1 = 0.50 \times \frac{W}{E \times \text{P.F.}} \text{ for two-phase circuit.}$$

$$1 = 0.58 \times \frac{W}{E \times \text{P.F.}} \text{ for three-phase circuit.}$$

1 = Current in line in amperes; W = energy delivered in watts; E = potential between mains in volts; P.F. = power factor. When power factor cannot be accurately determined it may be assumed as follows: Lighting load with no motors, 0.95; lighting and motors, 0.85; motors only, 0.80.

From the above formulae if W, E. and P.F. are the same it will be seen:

Current in each wire two-phase equals 0.5 current in each wire single phase.

Current in each wire three-phase equals 0.58 current in each wire single-phase.

Current in each wire three-phase equals 1.16 current in each wire two-phase.

On alternating-current systems of wiring, single-phase or 4-wire two-phase, that carry non-inductive loads, such as incandescent lamps, the printed wiring formula should be used, but where the load is inductive—motors or arc lamps—an addition of 25 per cent to the number of circular mils. obtained by the wiring formula is recommended, if the current required has been figured on the same basis as used for direct current, to compensate for the power factor. Single-phase 3-wire circuits may be figured on the same basis as direct-current 3-wire, if non-conductive.

THREE-PHASE WIRING

In a 3-wire balanced three-phase system the current in each wire of primary and secondary, to the point where the 3-wire system is divided into 2-wire, is 1.732 times the amount it would be if three separate single-phase circuits were used, owing to each wire having to carry current for two-phase.

For instance, in carrying 600 incandescent lamps, or 300 amperes—100 amperes on each phase—on 3-wire balanced three-phase secondary mains, the current in each of the three wires will be 100×1.732 , or 173.2 amperes, and this quantity should be used in the wiring formula.

In other respects the three-phase 3-wire system may be figured the same as a 2-wire system, and each of the three wires made the same size.

Three-phase motors generally bear the manufacturer's name-plate, showing amperes per phase, which represents the total current in each line wire, so that the multiplier of 1.732 should not be used to obtain size of copper.

In general:

$$\text{H. P.} = \frac{\text{Amperes per phase} \times \text{volts} \times 1.732 \times \text{power factor}}{746}$$

$$\text{Amperes per phase} = \frac{\text{H. P.} \times 746}{\text{Volts} \times 1.732 \times \text{power factor.}}$$

The term power factor is less than 1, and varies approximately from .65 for 1 H. P. to .90 for 50 H. P. motors. In calculating the total load from switchboard voltmeters and ammeters: Watts = amperes per phase $\times$ volts $\times$ 1.732 $\times$ power factor.

COPPER FOR VARIOUS SYSTEMS OF DISTRIBUTION

Power transmitted, distance, line loss and voltage of lamps constant. All wires of each system same size.

System.	Copper Required.
2-Wire, single-phase or direct current.....	1.000
3-Wire, single-phase or direct current.....	.375
4-Wire, single-phase or direct current.....	.222
4-Wire, two-phase.....	1.000
4-Wire, three-phase with neutral.....	.333
3-Wire, three-phase Delta.....	.75

USEFUL DATA WEIGHT OF COPPER

A convenient formula for weight of copper is as follows:
 $(\text{miles})^2 \times \text{K.W.} \times k.$

Lbs. copper in line = $\frac{\quad}{(K.X.)^2 \times \% \text{ loss.}}$

k = a constant depending on phase, system and power factor; for 100% power factor single or two-phase k = 363; for three-phase k = 273.

WIRING FORMULA FOR DIRECT CURRENT

D = distance (one way) in feet.

C = current in amperes.

CM = circular mils.

$$\text{Volts lost} = \frac{D \times 22 \times C}{\text{CM}}$$

$$\text{CM} = \frac{D \times 22 \times C}{\text{Volts lost.}}$$

The constant 22 is obtained as follows: A copper wire with a sectional area of 10.7 CM, has a resistance of one ohm per foot. One ampere through one ohm resistance loses one volt.

The distance being measured one way, we multiply by 2 to get the total length of the circuit. As $10.7 \times 2 = 21.4$ we may use 22 for simplicity, this being near enough for practical work.

WIRING FORMULA

From Ohms Law the proper size of wire that should be used to carry a current any distance with a given loss in volts can readily be determined, and the following is recommended:

$$\frac{\text{Length of run in feet} \times \text{amperes} \times 21.5}{\text{Volts lost.}} = \text{Circular Mils.}$$

In above the number of feet must be measured one way, not both sides of the circuit; volts lost should be taken as the drop allowed in volts, and circular mils. show the size of wire to use.

Example.—What size wire should be used on a 250-volt circuit where it is necessary to carry 200 amperes a distance of 350 feet to a center of distribution with a loss of 3 per cent under full load?

3 per cent of 250 = 7.5 volts lost.

$$\frac{350 \times 200 \times 21.5}{7.5} = 200667 \text{ circular mils., or No. 0000 B. \& S. gauge, which is the next size heavier.}$$

In using this or any other formula to determine the size of copper to use, care should be taken to see that the size adopted is not smaller than allowed in the Underwriters' table of safe carrying capacities, which are fixed without considering the loss in line.

The general practice in balanced 3-wire direct-current systems with a central neutral wire is to figure the line loss on the same basis as a 2-wire system of the voltage between the two outside wires with the amount of current carried in the outside wires. The central neutral wire should be made the same size as either of the others.

REASON WHY

For the benefit of those who care to know the reason why, the above Wiring Formula is based upon one foot of copper wire, with a cross sectional area of one circular mil., having a resistance of very close to 10.75 ohms, so that the resistance of any copper wire =

$$\frac{\text{Length in feet} \times 10.75}{\text{Circular mils.}}$$

Substituting this expression for R. in Ohm's Law:

$$E = \frac{C \times \text{length in feet} \times 10.75}{\text{Circular mils.}}$$

$$\text{and circular mils.} = \frac{C \times \text{length in feet} \times 10.75}{E}$$

In the Wiring Formula, however, the length in feet is considered the "run," one side of the circuit, and the term 10.75 is multiplied by 2.

SHERARDIZING

Because of the well-known fact that the "Hot Dip" Galvanizing Process of protecting iron against rust is very detrimental to malleable iron, the manufacturers of malleable iron pole line hardware have adopted sherardizing because it is not only a better rust preventative but it does not destroy the annealing, which is the desirable quality of malleable iron. The General Electric Co., The Westinghouse Electric and Manufacturing Co. and W. N. Matthews and Brother, Inc., have all adopted it for their pole line material.

Below are given a number of excerpts from a booklet published by the United States Sherardizing Co., showing the superiority of sherardizing:

1. The product is more durable and more finished in appearance than that of any other known process.
 2. The process does not reduce the strength of iron or steel, but on the contrary increases it.
 3. Bolts can be sherardized and it is unnecessary to recut the threads as in the case of hot dipped galvanized bolts.
 4. The zinc forms an alloy which can not be separated from the underlying metal and even if a portion of the coating is removed by filing, the bared portion will not corrode unless the metal underlying the alloy is exposed.
 5. An even coating of zinc is secured on both the inside and outside of hollow articles, irrespective of their size or shape.
 6. Sherardized surfaces are hard and withstand wear better than hot dipped or electro galvanized.
 7. Sherardized articles can be painted, which is not the case with hot dipped galvanizing.
 8. Sherardized articles have been chemically tested in a number of instances in comparison with articles treated by the hot dipped or electric process of zinc coating. In each instance they showed a marked superiority over the same articles treated by the latter methods.
- The A. T. & T. test requires that hot dipped galvanized articles shall stand four dips.

Properly sherardized articles (coated with $\frac{1}{2}$ -ounce of zinc per superficial foot) passed through eight or more dips without breaking down.

AMERICAN TELEPHONE AND TELEGRAPH CO. GALVANIZING TEST

Test: Samples properly selected should be thoroughly cleansed with a solution of potash or strong soap, using a soft cloth or cotton waste. They should then be rinsed in clear water, preferably running, and wiped dry. This washing should be done to completely cleanse the galvanizing from dirt, grease or other surface impurities.

Making sure that the samples are clean and dry, they should then be plunged into a bath of copper sulphate solution and kept there for one minute, then plunged into a bath of clean water and afterwards wiped dry. This process should be repeated until each sample has been immersed four times. After these immersions no sample should show any deposit of copper, thus indicating that the zinc coating has not been entirely removed.

Standard Solution: A solution of commercial copper sulphate crystals in water, specific gravity 1.185 at 70° Fahrenheit. This solution should be neutralized with commercially pure copper oxide and filtered. The best method of preparing the solution is secured by dissolving five parts, by weight, of commercially pure copper sulphate crystals in about fourteen parts, by weight, of water. While a sample is being tested the temperature of the solution should be at no time less than 60° Fahrenheit, nor more than 70° Fahrenheit.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



POLE LINE DATA

From Cushings Standard Wiring, 15th Edition, 1909

Gauge No. B. & S.....	4-0	3-0	2-0	1-0	1	2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8
Diam. bare wire in thousandths.....	.460	.40964	.3648	.3249	.2893	.2576	.2294	.2043	.1819	.1620	.1442	.1287
Ohms. Res. B. wire at 75° per mile.....	.2622	.33	.4164	.5252	.6642	.8337	1.058	1.333	1.6748	2.114	2.673	3.387
Weight (lbs.) per 1000 feet, Triple B.....	.775	.630	.490	.400	.306	.268	.210	.164	.145	.112	.....	.078
Weight (lbs.) per mile, Triple B.....	4092	3326	2587	2112	1616	1415	1109	866	766	591	.....	412

POLES PER MILE	Distance Between Poles, Feet		Approximate Weight of Triple Braid Wire Between Poles										
	264.00	210.73	171.31	133.24	108.78	83.21	72.87	57.10	44.59	39.43	30.45	.....	21.21
20.....	264.00	210.73	171.31	133.24	108.78	83.21	72.87	57.10	44.59	39.43	30.45	.....	21.21
21.....	251.40	200.66	163.14	126.87	103.58	77.24	69.39	54.38	42.46	37.54	29.00	.....	20.20
22.....	240.10	191.64	155.81	121.17	98.91	75.67	66.27	51.93	40.55	35.86	27.70	.....	18.29
23.....	229.56	183.24	148.96	115.85	94.57	72.36	63.36	49.65	38.77	34.28	26.48	.....	18.44
24.....	220.00	175.60	142.76	111.03	90.64	69.34	60.72	47.59	37.16	32.86	25.38	.....	17.67
25.....	211.20	168.59	137.04	106.58	87.01	66.56	58.29	45.68	35.68	31.54	24.36	.....	16.97
26.....	203.07	162.07	131.76	102.48	83.65	64.00	56.05	43.92	34.30	30.33	23.42	.....	16.32
27.....	195.55	156.10	126.90	98.69	80.56	61.64	53.97	42.29	33.03	29.21	22.56	.....	15.71
28.....	188.55	150.46	122.35	95.16	77.68	59.43	52.05	40.78	31.85	28.16	21.75	.....	15.15
29.....	182.09	145.34	118.10	91.89	75.01	57.39	50.26	39.30	30.76	27.19	21.00	.....	14.63
30.....	176.00	140.50	114.21	88.83	72.51	55.47	48.58	38.07	29.73	26.29	20.30	.....	14.14
31.....	170.30	135.92	110.51	85.95	70.16	53.67	47.00	36.83	28.77	25.43	19.64	.....	13.68
32.....	165.00	131.71	107.07	83.28	67.98	52.01	45.55	35.69	27.87	24.64	19.03	.....	13.26
33.....	160.00	127.72	103.82	80.75	65.92	50.43	44.16	34.61	27.03	23.90	18.46	.....	12.85
34.....	155.29	123.96	100.76	78.37	63.98	48.94	42.86	33.59	26.23	23.19	17.91	.....	12.47
35.....	150.85	120.38	97.89	76.14	62.15	47.55	41.64	32.63	25.48	22.53	17.40	.....	12.12
36.....	146.66	117.07	95.15	74.02	60.43	46.23	40.48	31.72	24.78	21.90	16.92	.....	11.78
37.....	142.70	113.90	92.60	72.02	58.79	44.98	39.39	30.87	24.10	21.31	16.46	.....	11.46
38.....	138.96	110.93	90.17	70.13	57.25	43.88	38.36	30.06	23.47	20.76	16.03	.....	11.16
39.....	135.38	108.05	87.84	68.33	55.77	42.67	37.37	29.28	22.86	20.22	15.62	.....	10.88
40.....	132.00	105.37	85.65	66.62	54.38	41.61	36.43	28.55	22.30	19.71	15.23	.....	10.61
41.....	128.78	102.79	83.56	64.99	53.05	40.59	35.54	27.85	21.75	19.23	14.85	.....	10.34
42.....	125.71	100.35	81.58	63.44	51.79	39.62	34.70	27.19	21.24	18.78	14.50	.....	10.10
43.....	122.79	98.01	79.68	61.97	50.59	38.70	33.89	26.56	20.74	18.34	14.17	.....	9.86
44.....	120.00	95.79	77.87	60.56	49.47	37.82	33.12	25.96	20.27	17.92	13.84	.....	9.64
45.....	117.33	93.66	76.15	59.21	48.38	36.98	32.38	25.38	19.82	17.52	13.53	.....	9.43
46.....	114.78	91.61	74.48	57.93	47.27	36.18	31.68	24.83	19.39	17.14	13.24	.....	9.22
47.....	112.34	89.67	72.89	56.70	46.28	35.40	31.01	24.30	18.98	16.78	12.96	.....	9.02
48.....	110.00	87.80	71.38	55.52	45.32	34.67	30.36	23.79	18.58	16.43	12.69	.....	8.84
49.....	107.75	86.01	69.92	54.38	44.39	33.96	29.74	23.31	18.20	16.09	12.43	.....	8.66
50.....	105.60	84.30	68.53	53.29	43.50	33.28	29.15	22.84	17.84	15.77	12.18	.....	8.48
51.....	103.52	82.63	67.18	52.24	42.65	32.63	28.57	22.39	17.49	15.46	11.95	.....	8.32
52.....	101.53	81.04	65.89	51.24	41.83	32.00	28.02	21.96	17.15	15.16	11.71	.....	8.16
53.....	99.64	79.54	64.65	50.29	41.05	31.40	27.50	21.55	16.83	14.88	11.49	.....	8.00
54.....	97.77	78.04	63.44	49.34	40.28	30.82	26.98	21.15	16.51	14.60	11.28	.....	7.85
55.....	96.00	76.63	62.29	48.45	39.55	30.25	26.50	20.76	16.21	14.34	11.07	.....	7.71



W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

CEDAR POLES FOR ELECTRIC LIGHT WORK

SIZE	Average Weight, Pounds, Each	No. of Poles to a Car.	SIZE	Average Weight, Pounds, Each	No. of Poles to a Car
25-foot, 5 -inch top....	200	150	35-foot, 7 -inch top....	650	90
25 " 5½ " " "....	225	130	40 " 6 " " "....	800	80
25 " 6 " " "....	250	100	40 " 7 " " "....	900	75
28 " 7 " " "....	400	80	45 " 6 " " "....	900	70
30 " 5 " " "....	300	110	45 " 7 " " "....	1000	65
30 " 6 " " "....	350	90	50 " 6 " " "....	1200	55
30 " 7 " " "....	420	75	55 " 6 " " "....	1400	45
35 " 6 " " "....	550	100			

SAG OF WIRES.

The wires should be strung with a uniform sag so that all the wires on each cross-arm shall be even and level.

The sag for No. 12 wires should be as given in the following table, making the allowance therein stated for temperature and length of span:—

Temperature—Degrees Fahrenheit.

Span in Feet	+100	+80	+60	+30	+10	—10	—30
	Sag of Wires—Inches						
75	4½	3	2½	2	1½	1½	1
100	7	5½	4½	3½	3	2½	2
115	9	7	5½	4	3½	3	2½
130	11	8½	7	5½	4½	4	3½
150	14	11½	9	7	6	5	4½
200	22½	19	15½	12	10½	9	8

The sag for No. 14 wire should be at least two (2) inches greater than that indicated in the above table for the same temperature and span. The sag for copper wire or special steel wire at long spans of over two hundred (200) feet should be as given in the following table, making the allowance therein for temperature and length of span:—

Temperature—Degrees Fahrenheit.

Span in Feet	+100	+65	+30	0	—30
200	22½ inches	17 inches	12 inches	9½ inches	8 inches
250	36 "	28 "	21 "	17½ "	14 "
300	55 "	44 "	33 "	27½ "	22 "
350	76 "	61 "	46 "	38½ "	31 "
400	8 feet	6½ feet	5 feet	51½ "	43 "
450	10 "	8 "	6½ "	68 "	58 "
500	12½ "	10 "	8 "	7 feet	6 feet
550	14½ "	12 "	9½ "	8½ "	7½ "
600	16 "	13½ "	11 "	10 "	9 "
650	18 "	15 "	12½ "	11 "	10 "
700	20 "	17 "	14 "	12½ "	11½ "
750	22 "	19 "	16 "	14½ "	13 "
800	24 "	21 "	18 "	16½ "	15 "
850	26 "	23 "	20 "	18½ "	17 "
900	28 "	25 "	22 "	20½ "	19 "
950	30½ "	27 "	24 "	22½ "	21 "
1000	33 "	29½ "	26½ "	25 "	23½ "
1100	38 "	34½ "	31½ "	30 "	28½ "
1200	44 "	40½ "	37½ "	35½ "	34 "
1300	49½ "	46 "	43 "	41 "	39½ "
1400	56 "	52½ "	49½ "	47½ "	46 "
1500	63 "	59½ "	56½ "	54½ "	53 "
1600	70 "	66½ "	63½ "	61½ "	60 "

USEFUL DATA

General Formulae (Ohm's Law).

C.=current in amperes. E.=electro-motive force. R.=resistance in ohms. W.=energy in watts.

$$C. = \frac{E}{R} \quad E. = C. R. \quad R. = \frac{E}{C} \quad C. E. = W. \quad W. = \frac{E^2}{R} \quad C^2 R. = W.$$

$$\frac{W}{746} = H. P.$$

$$W. = 746 \times H. P.$$

Formulae giving the volts or amperes necessary for a given horse power on circuits of constant current, and constant potential, respectively:

$$E. = \frac{746 \times H. P.}{C. \times K.}$$

$$C. = \frac{746 \times H. P.}{E. \times K.}$$

E. = potential of circuit. C. = amperes. K. = efficiency of machine. H. P.=horse power.

GENERAL FORMULAE FOR LIGHT AND POWER WIRING

c. m. = circular mils.

d. = length of wire, in feet, on one side of circuit.

n. = number of lamps in multiple.

c. = current in amperes per lamp.

v. = volts lost in lines.

r. = resistance per foot of wire to be used.

10.8 ohms = resistance of one foot of commercial copper wire having a diameter of one mil. and a temperature of 75° Fahrenheit.

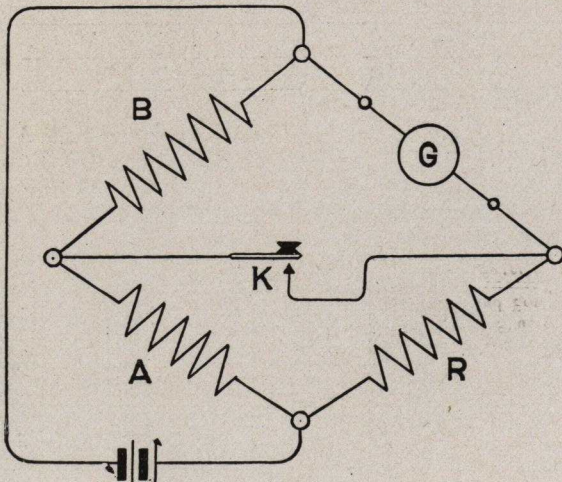
It is an easy matter to find any of the above values by the following formulae:

$$c. m. = \frac{10.8 \times 2d. \times n. \times c.}{v.} \quad v. = \frac{10.8 \times 2d. \times n. \times c.}{c. m.} \quad n. = \frac{c. m. \times v.}{10.8 \times 2d. \times c.}$$

$$r. = \frac{v.}{n. \times c. \times 2d.} \quad v. = n. \times c. \times 2d. \times r. \quad n. = \frac{v.}{c. \times 2d. \times r.}$$

$$c. = \frac{c. m. \times v.}{10.8 \times 2d. \times n.} \quad 2d. = \frac{c. m. \times v.}{10.8 \times c. \times n.} \quad c. = \frac{v.}{2d. \times n. \times r.} \quad 2d. = \frac{v.}{n. \times c. \times r.}$$

RESISTANCE OF GALVANOMETER



To find resistance of Galvano-meter, connect bridge as shown and adjust rheostat "R" until deflection of "G" is the same whether key "K" is open or closed.

$$\text{Then resistance of } G = R \frac{B}{A}$$

USEFUL DATA

BREAKING WEIGHTS

English System.

From "Standard Wiring for Electric Light and Power," by H. C. Cushing, Jr., New York.

Numbers B. & S. Gauge	Diameter in mils.	Breaking Weight Hard Drawn Copper Pounds	Breaking Weight "Phono-Electric" Pounds
0000.....	460.0	8310	11460
000.....	409.6	6580	9140
00.....	364.8	5226	7400
0.....	324.9	4558	6300
1.....	289.3	3746	5250
2.....	257.6	3129	4180
3.....	229.4	2480	3360
4.....	204.3	1967	2700
5.....	181.9	1559	2080
6.....	162.0	1237	1680
7.....	144.3	980	1350
8.....	128.5	778	1075
9.....	114.4	617	850
10.....	101.9	489	685
11.....	90.74	388	545
12.....	80.81	307	420
13.....	71.96	245	340
14.....	64.08	193	270
15.....	57.07	153	220
16.....	50.82	133	180
17.....	45.26	97	135
18.....	40.30	77	107

ELASTIC LIMIT.

Wire	Numbers B. & S. Gauge	Diameter in Mils.	Tensile Strength pounds per square inch	Elastic Limit pounds per square inch
Hard Drawn Copper.....	00	346.8	52000	41775
"Phono-Electric".....	00	364.8	73500	57860
Hard Drawn Copper.....	0	324.9	54000	39645
"Phono-Electric".....	0	324.9	76500	55195

OUTSIDE DIAMETERS OF RUBBER COVERED CABLES

OUTSIDE DIAMETERS OF WEATHER- PROOF WIRE

From Horstmann & Tousley's "Electric Wiring and Construction Tables," 1907.

Capacity in Cir. Mils.	Diameter over Braid	Size of Wire	Outside Diameters	
			Solid	Stranded
1,500,000	113/64	1,000,000	.....	108/64
1,250,000	107/64	900,000	.....	103/64
1,000,000	97/64	800,000	.....	100/64
950,000	95/64	700,000	.....	94/64
900,000	94/64	600,000	.....	85/64
850,000	93/64	500,000	.....	80/64
800,000	89/64	450,000	.....	76/64
750,000	87/64	400,000	.....	73/64
700,000	83/64	350,000	.....	64/64
650,000	81/64	300,000	.....	62/64
600,000	79/64	250,000	.....	58/64
550,000	76/64	00000	50/64	55/64
500,000	73/64	000	47/64	51/64
450,000	68/64	00	39/64	43/64
400,000	66/64	00	36/64	39/64
350,000	64/64	1	32/64	35/64
300,000	61/64	2	30/64	33/64
250,000	59/64	3	27/64	30/64
		4	25/64	28/64
		5	22/64	24/64
		6	20/64	22/64
		8	17/64	18/64
		10	16/64	.....
		12	14/64	.....
		14	12/64	.....
		16	10/64	.....
		18	8/64	.....

USEFUL DATA

BROWN & SHARPE'S GAUGE

The B. & S. Gauge is standard for copper wire and is understood to apply to all cases where size of copper wire is mentioned in any wire gauge number.

By referring to table it will be seen that in the B. & S. Gauge, to all practical purposes, the area in circular mils. is doubled for every third size heavier, by gauge number, and halved for every third size lighter, by gauge number.

Every tenth size heavier by gauge number has ten times the area in circular mils.

Every 10 B. & S. Gauge wire has an area of approximately 10,000 circular mils., and from this base the other sizes can be figured, if a table should not be at hand.

CLASSIFICATION OF GAUGES

In addition to the confusion caused by a multiplicity of wire gauges, several of them are known by various names.

For example:

Brown & Sharpe (B. & S.) = American Wire Gauge (A. W. G.).

New British Standard (N. B. S.) = British Imperial, English Legal Standard and Standard Wire Gauge and is variously abbreviated by S. W. G. and I. W. G.

Birmingham Gauge (B. W. G.) = Stubs', Old English Standard and Iron Wire Gauge.

Roebling = Washburn Moen, American Steel and Wire Co.'s Iron Wire Gauge.

London = Old English (not Old English Standard).

As a further complication:

Birmingham or Stubs' Iron Wire Gauge is not the same as Stubs' Steel Wire Gauge.

GENERAL USES OF VARIOUS GAUGES

B. & S. G.—All forms of round wires used for electrical conductors. Sheet copper, brass and German silver.

U. S. S. G.—Sheet iron and steel. Legalized by act of Congress, March 3, 1893.

B. W. G.—Galvanized iron wire. Norway iron wire.

American Screw Co.'s Wire Gauge.—Numbered sizes of machine and wood screws, particularly up to No. 14 (.2421 inch).

Stubs' Steel Wire Gauge.—Drill rod.

Roebling & Trenton.—Iron and steel wire. Telephone and telegraph wire.

N. B. S.—Hard drawn copper. Telephone and telegraph wire.

London Gauge.—Brass wire.

EQUIVALENTS OF WIRES—B. & S. GAUGE

0000	=	2-0	=	4-3	=	8-6	=	16-9	=	32-12	=	64-15
000	=	2-1	=	4-4	=	8-7	=	16-10	=	32-13	=	64-16
00	=	2-2	=	4-5	=	8-8	=	16-11	=	32-14	=	64-17
0	=	2-3	=	4-6	=	8-9	=	16-12	=	32-15	=	.....
1	=	2-4	=	4-7	=	8-10	=	16-13	=	32-16	=	.....
2	=	2-5	=	4-8	=	8-11	=	16-14	=	32-17	=	.....
3	=	2-6	=	4-9	=	8-12	=	16-15	=	32-18	=	.....
4	=	2-7	=	4-10	=	8-13	=	16-16	=	.....	=	.....
5	=	2-8	=	4-11	=	8-14	=	16-17	=	.....	=	.....
6	=	2-9	=	4-12	=	8-15	=	16-18	=	.....	=	.....
7	=	2-10	=	4-13	=	8-16	=	.....	=	.....	=	.....
8	=	2-11	=	4-14	=	8-17	=	.....	=	.....	=	.....
9	=	2-12	=	4-15	=	8-18	=	.....	=	.....	=	.....
10	=	2-13	=	4-16	=	.....	=	.....	=	.....	=	.....
11	=	2-14	=	4-17	=	.....	=	.....	=	.....	=	.....
12	=	2-15	=	4-18	=	.....	=	.....	=	.....	=	.....
13	=	2-16	=	4-19	=	.....	=	.....	=	.....	=	.....
14	=	2-17	=	.....	=	.....	=	.....	=	.....	=	.....
15	=	2-18	=	.....	=	.....	=	.....	=	.....	=	.....
16	=	2-19	=	.....	=	.....	=	.....	=	.....	=	.....

USEFUL DATA

DATA ON SOLID WIRES LARGER THAN 4/0

No. B. & S. Gauge.	Dia. Mils.	Circular Mils.	Feet Per Pound	Lbs. Per Foot.	Ohms Per Mile.
5/0	515	265,225	1.29	.80	.206
6/0	575	330,625	1.00	1.00	.165
7/0	640	409,600	.81	1.24	.133
8/0	710	504,100	.66	1.53	.108
9/0	785	616,225	.54	1.86	.089
10/0	865	748,225	.44	2.25	.073
11/0	950	902,500	.37	2.73	.060
12/0	1040	1,081,600	.21	3.27	.050

TABLE SHOWING DIFFERENCE BETWEEN WIRE GAUGES IN DECIMAL PARTS OF AN INCH

No. of Wire	Old English from Brass Mfrs. List	New British	Trenton Iron Co., Trenton, N. J.	Washburn & Moen Mfg. Co., Worcester, Mass.	Birmingham or Stubbs	American or Brown & Sharpe	No. of Wire Gauge	No. of Wire	Old English from Brass Mfrs. List	New British	Trenton Iron Co., Trenton, N. J.	Washburn & Moen Mfg. Co., Worcester, Mass.	Birmingham or Stubbs	American or Brown & Sharpe	No. of Wire Gauge
18	.049	.048	.045	.047	.049	.040303	18	000000	.045	.046	.045	.047	.049	.040303	18
19	.04	.04	.039	.041	.042	.03589	19	000000	.04	.041	.04	.042	.043	.03589	19
20	.035	.036	.034	.035	.035	.031961	20	0000	.035	.036	.035	.035	.036	.031961	20
21	.0315	.032	.03	.032	.032	.025462	21	000	.0315	.032	.031	.032	.033	.025462	21
22	.0295	.028	.028	.028	.028	.025347	22	00	.0295	.028	.028	.028	.028	.025347	22
23	.027	.024	.024	.025	.025	.022571	23	0	.027	.024	.024	.025	.025	.022571	23
24	.025	.022	.0215	.022	.022	.0201	24	1	.025	.022	.022	.022	.022	.0201	24
25	.023	.02	.019	.02	.02	.0179	25	2	.023	.02	.019	.02	.02	.0179	25
26	.02	.018	.018	.018	.018	.01594	26	3	.02	.018	.018	.018	.018	.01594	26
27	.0205	.018	.017	.017	.017	.014195	27	4	.0205	.018	.017	.017	.017	.014195	27
28	.01875	.0165	.016	.016	.016	.012641	28	5	.01875	.0165	.016	.016	.016	.012641	28
29	.0165	.0155	.015	.015	.015	.011257	29	6	.0165	.0155	.015	.015	.015	.011257	29
30	.01375	.0124	.0124	.0124	.0124	.010025	30	7	.01375	.0124	.0124	.0124	.0124	.010025	30
31	.01225	.0116	.0116	.0116	.0116	.008928	31	8	.01225	.0116	.0116	.0116	.0116	.008928	31
32	.0108	.0103	.0103	.0103	.0103	.00795	32	9	.0108	.0103	.0103	.0103	.0103	.00795	32
33	.0095	.0092	.0092	.0092	.0092	.00708	33	10	.0095	.0092	.0092	.0092	.0092	.00708	33
34	.0085	.0084	.0084	.0084	.0084	.005614	34	11	.0085	.0084	.0084	.0084	.0084	.005614	34
35	.0075	.0076	.0076	.0076	.0076	.005	35	12	.0075	.0076	.0076	.0076	.0076	.005	35
36	.0065	.0068	.0068	.0068	.0068	.004453	36	13	.0065	.0068	.0068	.0068	.0068	.004453	36
37	.00575	.0056	.0056	.0056	.0056	.003965	37	14	.00575	.0056	.0056	.0056	.0056	.003965	37
38	.0052	.0052	.0052	.0052	.0052	.003531	38	15	.0052	.0052	.0052	.0052	.0052	.003531	38
39	.0048	.0048	.0048	.0048	.0048	.003144	39	16	.0048	.0048	.0048	.0048	.0048	.003144	39
40							40	17							40

CONDUCTIVITIES

Metals.	At 0° C. At 32° F.	At 100° C. At 212° F.	Metals.	At 0° C. At 32° F.	At 100° C. At 212° F.
Silver, hard	100.	71.56	Tin	12.36	8.67
Copper, hard	99.95	70.27	Lead	8.32	5.86
Gold, hard	77.96	55.90	Arsenic	4.76	3.33
Zinc, pressed	29.02	20.67	Antimony	4.62	3.26
Cadmium	23.72	16.77	Mercury, pure	1.60	
Platinum, soft	18.00		Bismuth	1.245	0.878
Iron, soft	16.80				

CONDUCTORS AND INSULATORS IN ORDER OF THEIR VALUE

Conductors.		Insulators (Non-conductors).			
All metals	Metallic ores	Dry air	Sulphur	Ebonite	Parchment
Well-burned charcoal	Animal fluids	Shellac	Wax	Gutta-percha	Dry leather
Plumbago	Living vegetable substances	Paraffin	Jet	India-rubber	Porcelain
Acid solutions	Moist earth	Amber	Glass	Silk	Oils
Saline solutions	Water	Resins	Mica	Dry paper	

According to Culley, the resistance of distilled water is 6,754 million times as great as that of copper.

USEFUL DATA STRANDED CONDUCTORS

Size B. & S.	Weatherproof Wire			Slow-Burning Weatherproof Wire			Slow-Burning Wire		
	Weight Per 1,000 Ft.	Weight Per Mile	Diam- eter Over All	Weight Per 1,000 Ft.	Weight Per Mile	Diam- eter Over All	Weight Per 1,000 Ft.	Weight Per Mile	Diam- eter Over All
2000000 C.M.	7000	37000	2 1/8	7300	38500	2	7800	41000	2
1750000 C.M.	6200	32750	2	6550	34600	1 7/8	6900	36300	1 7/8
1500000 C.M.	5400	28500	1 7/8	5675	30000	1 3/4	6000	31300	1 3/4
1250000 C.M.	4500	23800	1 3/4	4780	25200	1 11/16	5000	26400	1 11/16
1000000 C.M.	3675	19400	1 21/32	3860	20400	1 39/64	3980	21000	1 39/64
900000 C.M.	3330	17600	1 39/64	3520	18600	1 9/16	3640	19200	1 9/16
800000 C.M.	3000	15800	1 9/16	3180	16800	1 33/64	3280	17300	1 33/64
700000 C.M.	2650	14000	1 15/32	2820	14900	1 27/64	2920	15400	1 27/64
600000 C.M.	2235	11800	1 21/64	2350	12400	1 9/32	2460	13000	1 9/32
500000 C.M.	1900	10000	1 1/4	1990	10500	1 13/64	2080	11000	1 13/64
450000 C.M.	1725	9100	1 3/16	1820	9600	1 9/64	1900	10000	1 9/64
400000 C.M.	1550	8200	1 9/64	1650	8700	1 3/32	1700	9000	1 3/32
350000 C.M.	1345	7100	1	1440	7600	1 1/32	1500	7900	31/32
300000 C.M.	1175	6200	31/32	1270	6700	15/16	1310	6900	15/16
250000 C.M.	985	5200	29/32	1060	5600	7/8	1120	5900	7/8
0000	800	4220	55/64	900	4750	53/64	940	5070	53/64
000	653	3450	51/64	735	3880	49/64	785	4150	49/64
00	522	2760	43/64	583	3080	41/64	625	3300	41/64
0	424	2240	39/64	480	2530	37/64	510	2700	37/64
1	328	1735	35/64	355	1870	33/64	380	2000	33/64
2	270	1425	33/64	290	1540	31/64	335	1770	31/64
3	206	1090	15/32	240	1270	29/64	280	1480	29/64
4	170	900	7/16	195	1030	27/64	230	1220	27/64
5	140	740	3/8	160	845	3/8	195	1030	3/8
6	115	610	11/32	132	695	11/32	165	870	11/32
8	78	410	9/32	87	460	9/32	105	555	9/32

ANNUNCIATOR WIRE

Size B & S.	Pounds per 1,000 Ft.	Diameter Over All
14	15.	.....
16	9.5	.....
18	6.5	.....
20	4.5	.....

DAMP-PROOF OFFICE WIRE

Size B. & S.	Pounds per 1,000 Ft.
12	34.
14	24.
16	13.5
18	10.
20	8.

FIXTURE WIRE—HEAVY

Size B. & S.	Pounds per 1,000 Ft.	Diameter Over All
14	27	3/16
16	17	5/32
18	12	1/32
19	11	1/8
20	10	1/8

WEATHERPROOF TWISTED PAIRS

	Per 1,000 Ft.
14	53
16	32
18	23
19	20

WEATHERPROOF IRON WIRE

	Pounds per Mile
8	470
9	400
10	350
12	230
14	150

TROLLEY WIRE

	Pounds per Mile
0000	3376
000	2677
00	2123
0	1684

LIGHT WALL

	Pounds per 1,000 Ft.	Diameter Over All
16	12	1/8
18	9	7/64
19	8	7/64
20	7	3/32

All Weights are Approximate, but are Exact Enough for all Practical Purposes.

USEFUL DATA STRANDED CONDUCTORS

Size B. & S.	Concentric Strands		Diam. of Con- ductors Mils.	Single Braid		Double Braid	
	No. Wires	Diam. Each		Diam. Over All	Weight Per 1000 Ft.	Diam. Over All	Weight Per 1000 Ft.
2000000 C. M.	91	148	1650	2	7246	2 9/64	7385
1750000 C. M.	91	139	1550	1 29/32	6394	2 3/64	6525
1500000 C. M.	91	128	1430	1 51/64	5539	1 15/16	5658
1250000 C. M.	91	117	1308	1 43/64	4678	1 13/16	4783
1000000 C. M.	61	128	1166	1 1/2	3754	1 5/8	3849
900000 C. M.	61	121	1104	1 7/16	3404	1 9/16	3491
800000 C. M.	61	115	1049	1 3/8	3058	1 1/2	3138
750000 C. M.	61	111	1013	1 11/32	2881	1 15/32	2956
700000 C. M.	61	107	978	1 5/16	2709	1 7/16	2880
650000 C. M.	61	103	943	1 17/64	2534	1 25/64	2600
600000 C. M.	61	99	906	1 1/4	2355	1 3/8	2418
550000 C. M.	61	95	870	1 13/64	2182	1 21/64	2240
500000 C. M.	37	116	821	1 1/8	1959	1 1/4	2010
450000 C. M.	37	110	779	1 3/32	1791	1 7/32	1840
400000 C. M.	37	104	738	1 3/64	1608	1 11/64	1650
350000 C. M.	37	97	688	1	1431	1 1/8	1468
300000 C. M.	37	90	639	15/16	1254	1 1/16	1285
250000 C. M.	37	82	583	7/8	1071	1	1103
0000	19	.105	530	13/16	899	15/16	942
000	19	.094	475	3/4	740	7/8	782
00	19	.083	425	45/64	607	13/16	647
0	19	.074	380	5/8	492	47/64	526
1	19	.066	329	9/16	387	43/64	417
2	19	.059	296	1/2	303	39/64	329
3	7	.086	263	29/64	249	9/16	272
4	7	.077	233	7/16	204	17/32	227
5	7	.068	209	13/32	175	1/2	192
6	7	.061	185	3/8	141	29/64	156
8	7	.048	147	21/64	90	13/32	103
10	7	.039	118	19/64	65	3/8	72
12	7	.031	94	17/64	48	21/64	55
14	7	.024	75	15/64	36	19/64	40

FINE MAGNET WIRE

No. B. & S. Gauge	Diameter	Ohms Per Pound		Feet Per Pound	
		Single Cotton	Double Cotton	Single Cotton	Double Cotton
20	.0319	3.15	3.02	311	298
21	.0284	4.97	4.72	389	370
22	.0253	7.87	7.44	491	461
23	.0225	12.45	11.7	624	584
24	.0201	19.65	18.25	778	745
25	.0179	30.9	28.45	958	903
26	.0159	48.5	44.3	1188	1118
27	.0142	76.5	68.8	1533	1422
28	.0126	120.0	106.5	1903	1759
29	.0112	190.5	164.0	2461	2207
30	.0100	294.5	252.0	2893	2534
31	.0089	461.	384.5	3483	2768
32	.0079	717.	585.	4414	3737
33	.0070	1115.	880.	5688	4697
34	.0063	1715.	1315.	6400	6168
35	.0056	2640.	1960.	8393	6737
36	.0050	4070.	2890.	9846	7877
37	.0044	6180.	4230.	11636	9309
38	.0039	9430.	6150.	13848	10666
39	.0035	14200.	8850.	18286	11907
40	.0031	21300.	12500.	24381	14222

USEFUL DATA

WEATHERPROOF WIRES—SOLID CONDUCTORS

Size B & S.	Weatherproof Wire			Slow-Burning Weatherproof Wire			Slow-Burning Wire		
	Wt. per 1,000 Ft.	Weight per Mile	Diameter Over All	Wt. per 1,000 Ft.	Weight per Mile	Diameter Over All	Wt. per 1,000 Ft.	Weight per Mile	Diameter Over All
0000	767	4050	25/32	862	4550	3/4	925	4890	3/4
000	630	3220	47/64	710	3750	45/64	760	4020	45/64
00	502	2650	39/64	562	2970	37/64	600	3170	37/64
0	407	2150	9/16	462	2440	17/32	495	2610	17/32
1	316	1670	1/2	340	1800	15/32	365	1930	15/32
2	260	1370	15/32	280	1480	7/16	320	1690	7/16
3	200	1050	27/64	230	1220	13/32	270	1425	13/32
4	164	865	25/64	190	1000	3/8	220	1160	3/8
5	134	710	11/32	155	820	11/32	190	1000	11/32
6	112	590	5/16	127	670	5/16	160	845	5/16
8	75	395	17/64	85	450	7/64	100	530	17/64
10	53	280	1/4	60	315	1/4	80	420	1/4
12	35	185	7/32	42	220	7/32	55	290	7/32
14	25	130	3/16	30	160	3/16	40	210	3/16
16	14	75	5/32	15	80	5/32	18	95	5/32
18	11	58	1/8	12	63	1/8	14	75	1/8

RUBBER COVERED WIRE—SOLID CONDUCTORS

Size B. & S.	Diameter of Conductors, Mils	Capacity, Circular Mils	Single Braid		Double Braid	
			Diameter Over All	Weight per 1,000 Ft.	Diameter Over All	Weight per 1,000 Ft.
0000	460	211600	47/64	809	55/64	832
000	410	167803	11/16	666	13/16	690
00	365	133079	5/8	546	47/64	568
0	325	105524	19/32	453	45/64	476
1	289	83695	33/64	355	5/8	376
2	258	66373	29/64	275	9/16	295
3	230	52634	27/64	227	33/64	245
4	204	41743	25/64	186	15/32	200
5	182	33102	23/64	160	7/16	170
6	162	26250	5/16	128	25/64	135
8	129	16510	17/64	80	11/32	86
10	102	10382	15/64	58	19/64	64
12	81	6530	7/32	43	9/32	48
14	64	4107	13/64	32	1/4	37
16	51	2583	3/16	20	.....	.....
18	40	1624	11/64	16	.....	.....
19	36	1288	5/32	15	.....	.....
20	32	1022	9/64	14	.....	.....

RUBBER COVERED DUPLEX

Size B. & S.	Solid		Stranded	
	Diameter Over All	Weight per 1,000 Ft.	Diameter Over All	Weight per 1,000 Ft.
1	.....	.....	1 1/4	810
2	.....	.....	1 1/8	638
3	.....	.....	1 1/32	528
4	.....	.....	31/32	442
5	.....	.....	29/32	375
6	.....	.....	53/64	307
8	11/16	170	49/64	203
10	37/64	125	5/8	143
12	1/2	94	9/16	107
14	27/64	73	15/32	78

All Weights are Approximate, but are Exact Enough for all Practical Purposes.

USEFUL DATA

DIMENSIONS, RESISTANCES AND SAFE CARRYING CAPACITY OF COPPER WIRES

B. & S. Gauge No.	Diameter in Mils. or Thousandths of an Inch	Area in Circular Mils.	Ohms Per 1000 Ft.	Lbs. Per 1000 Ft. W. P. Ins.	Safe Amperes	
					Rubber Covered	Weatherproof
....	1,000	1,000,000	.01038	3,550	650	1,000
....	894	800,000	.01297	2,880	550	840
....	775	600,000	.0173	2,210	450	680
....	707	500,000	.02076	1,875	390	590
....	632	400,000	.02596	1,530	330	500
....	548	300,000	.0346	1,185	270	400
0000	460	211,600	.04906	750	210	312
000	410	167,805	.06186	600	177	262
00	365	133,079	.07801	500	150	220
0	325	105,592	.0983	400	127	185
1	289	83,694	.1240	300	107	156
2	258	66,373	.1564	250	90	131
3	229	52,633	.1972	200	76	110
4	204	41,742	.2487	160	65	92
5	182	33,102	.3136	140	54	77
6	162	26,250	.3955	110	46	65
8	128	16,509	.6288	75	33	46
10	102	10,381	1.0	50	24	32
12	81	6,530	1.590	35	17	23
14	...	4,107	2.591	25	12	16
16	51	2,583	4.019	16	6	8
18	40	1,624	6.391	12	3	5

TO DETERMINE THE SIZE OF COPPER WIRE FOR ANY GIVEN SERVICE

Let C. M. = Cir. Mils.

Let D. = Distance.

Let C. = Current.

Let L. = Loss in Volts.

21.5 is a "Constant" or figure always used.

$$C \times D \times 21.5$$

$$\text{Then } \frac{\quad}{L} = \text{Cir. Mils.}$$

L.

Example.—It is required that 100 amperes be carried 350 feet on a 110-volt circuit, with a loss of 2 per cent in voltage. What is the Cir. Mils. required?

Example.—First, ascertain the loss in volts, or 2 per cent, of 110 = 2.2 volts.

$$100 \times 350 \times 21.5$$

$$= 337.500 \text{ Cir. Mils. or two No. 000 Wires.}$$

2.2

Where a wiring table is not at hand and it is desired to ascertain the weight of any bare copper conductor, it can be roughly determined in accordance with the following:

1,000 feet of wire, having an area of 1,000 circular mils., weighs approximately three pounds, and the weight of any bare conductor can, therefore, be determined by multiplying its area in circular mils. by .003.

GALVANIZED IRON WIRE—WEIGHT AND RESISTANCE CALCULATED AT 68° F.

Iron Wire Gauge	Diameter in Mils.	Pounds Per Mile	Ohms Resistance Per Mile		
			E. B. B.	B. B.	Steel
4	.225	730	6.44	7.53	8.90
6	.192	540	8.70	10.19	12.04
8	.162	380	12.37	14.47	17.10
9	.148	320	14.69	17.19	20.31
10	.135	260	18.08	21.15	25.00
11	.120	214	21.96	25.70	30.37
12	.105	165	28.48	33.33	39.39
14	.080	96	48.98	57.29	67.71

USEFUL DATA

CURRENT REQUIRED TO FUSE WIRES OF COPPER, GERMAN SILVER AND IRON

B. & S. Gauge	Copper, Amperes	German Silver, Amperes	Iron Amperes	B. & S. Gauge	Copper, Amperes	German Silver, Amperes	Iron, Amperes
10	333.	169.	101.	26	20.6	10.6	6.22
11	284.	146.	86.	27	17.7	9.1	5.36
12	235.	120.7	71.2	28	14.7	7.5	4.45
13	200.	102.6	63.	29	12.5	6.41	3.79
14	166.	85.2	50.2	30	10.25	5.26	3.11
15	139.	71.2	42.1	31	8.75	4.49	2.65
16	117.	60.0	35.5	32	7.26	3.73	2.2
17	99.	50.4	32.6	33	6.19	3.18	1.88
18	82.8	42.5	25.1	34	5.12	2.64	1.55
19	66.7	34.2	20.2	35	4.37	2.24	1.33
20	58.3	29.9	17.7	36	3.62	1.86	1.09
21	49.3	25.3	14.9	37	3.08	1.58	.93
22	41.2	21.1	12.5	38	2.55	1.31	.77
23	34.5	17.7	10.9	39	2.20	1.13	.67
24	28.9	14.8	8.76	40	1.86	.95	.56
25	24.6	12.6	7.46				

CONDUIT SIZES FOR DIFFERENT SIZE WIRES

No. B. & S.	Circular Mils.	Amperes Rubber	Size of Pipe			Circular Mils.	Amperes Rubber	Size of Pipe		
			1 Wire	2 Wire	3 Wire			1 Wire	2 Wire	3 Wire
18	1,020	3	½	½	½	500,000	390	2	3	3½
16	2,583	6	½	½	½	550,000	420	2	3½	4
14	4,107	12	½	½	¾	600,000	450	2	3½	4
12	6,530	17	½	¾	¾	650,000	475	2	3½	4
10	10,380	24	½	¾	1	700,000	500	2	3½	4
8	16,510	33	½	1	1	750,000	525	2	3½	4
6	26,250	46	¾	1	1¼	800,000	550	2	3½	4
5	33,100	54	¾	1¼	1¼	850,000	575	2½	4	4
4	41,740	65	¾	1¼	1½	900,000	600	2½	4	4½
3	52,630	76	¾	1¼	1½	950,000	625	2½	4	4½
2	66,370	90	¾	1½	2	1,000,000	650	2½	4	4½
1	83,690	107	1	1½	2	1,100,000	690	2½	4	5
0	105,500	127	1	2	2	1,200,000	730	2½	4	5
2.0	133,100	150	1	2	2	1,300,000	770	2½	4½	5
3.0	167,800	177	1¼	2	2½	1,400,000	810	3	4½	6
4.0	211,600	210	1¼	2	2½	1,500,000	850	3	5	6
	200,000	200	1¼	2	2½	1,600,000	890	3	5	6
	250,000	235	1½	2½	2½	1,700,000	930	3	5	6
	300,000	270	1½	2½	3	1,800,000	970	3	6	7
	350,000	300	1½	2½	3	1,900,000	1010	3	6	7
	400,000	330	1½	3	3	2,000,000	1050	3	6	7
	450,000	380	2	3	3½					

In laying out a conduit job, first ascertain the size and number of wires required, then take the sizes of conduit from the above table. One-half inch is usually used for branch conduits and is the smallest size permitted by the National Electric Code. In running several conduits together, a pull box will be found more economical than elbows for making turns, as one pull box will take the place of several elbows. Do not pull wires through conduits with a block and tackle, as it will not only injure the insulation, but wedge the wires in such shape that they cannot be removed readily if desired. Be careful to ream out the end when conduit is cut, as the burr may otherwise cut through the insulation. Conduits should be securely fastened to walls and ceiling by use of pipe straps or hooks. Plug all exposed ends of conduit in new buildings to prevent plaster and dirt from falling into it.

USEFUL DATA

MELTING POINT AND RELATIVE ELECTRICAL CONDUCTIVITY OF DIFFERENT METALS AND ALLOYS

Metals	Relative Con-ductivity	Melting Point ° F.	Metals	Relative Con-ductivity	Melting Point ° F.
Pure Silver.....	100.0	1873	Phosphor-tin.....	17.7	
Pure Copper.....	100.0	2550	Alloy of gold and silver (50%).....	16.12	
Refined and crystallized copper.....	99.9		Swedish iron.....	16.0	4000
Telegraphic silicious bronze.....	98.0		Pure Banca Tin.....	15.45	442
Alloy of copper and silver (50%).....	86.65		Antimonial copper.....	12.7	
Pure gold.....	78.0	2016	Aluminum bronze (10%)..	12.6	
Silicide of copper, 4% Si.	75.0		Siemens steel.....	12.0	
Silicide of copper, 12% Si.	54.7		Pure platinum.....	10.6	4100
Pure Aluminum.....	54.2	1160	Copper with 10% of nickel.....	10.6	
Tin with 10% of sodium	46.9		Cadmium Amalgam (15%)	10.2	
Telephonic silicious bronze.....	35.0		Dronier mercurial bronze	10.14	
Copper with 10% of lead	30.0		Arsenical copper (10%)...	9.1	
Pure zinc.....	29.9	773	Pure lead.....	8.88	630
Telephonic phosphor-bronze.....	29.0		Bronze with 20% of tin..	8.4	
Silicious brass, 25% zinc	26.49		Pure nickel.....	7.89	2800
Brass with 35% zinc....	21.5		Phosphor-bronze, 10% tin.....	6.5	
			Phosphor-copper, 9% phos.	4.9	
			Antimony.....	3.88	840

TABLE OF CARRYING CAPACITY OF WIRES

Below is a table showing the allowable carrying capacity of wires containing ninety-eight per cent pure copper, which must be followed in placing interior conductors:

RUBBER COVERED WIRES

B. & S. Gauge	Amperes	Circular Mils.	Amperes
18.....	3	200,000.....	200
16.....	6	300,000.....	270
14.....	12	400,000.....	330
12.....	17	500,000.....	390
10.....	24	600,000.....	450
8.....	33	700,000.....	500
6.....	46	800,000.....	550
5.....	54	900,000.....	600
4.....	65	1,000,000.....	650
3.....	76	1,100,000.....	690
2.....	90	1,200,000.....	730
1.....	107	1,300,000.....	770
0.....	127	1,400,000.....	810
00.....	150	1,500,000.....	850
000.....	177	1,600,000.....	890
0000.....	210	1,700,000.....	930
		1,800,000.....	970
		1,900,000.....	1010
		2,000,000.....	1050

The low limit is specified for rubber covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

APPROXIMATE WEIGHT PER 100 OF MACHINE BOLTS WITH SQUARE HEADS AND SQUARE NUTS

Length, Inches	1/4 Lbs.	5/16 Lbs.	3/8 Lbs.	7/16 Lbs.	1/2 Lbs.	9/16 Lbs.	5/8 Lbs.	3/4 Lbs.	7/8 Lbs.
3/4...	2.55	4.4	7.71	10.	.....	.....	.....	.....	.....
7/8...	2.64	4.65	8.04	10.53	.....	.....	.....	.....	.....
1.....	2.73	4.9	8.36	11.03	15.5	19.8	28.95	47.63	.....
1 1/4...	2.9	5.4	9.01	11.9	16.7	21.6	30.89	50.10	.....
1 1/2...	3.08	5.9	9.66	12.8	17.9	23.4	31.83	52.57	81.25
2.....	3.43	6.8	10.94	14.5	20.4	27.0	36.70	57.60	90.63
2 1/2...	4.45	7.8	12.74	17.25	24.91	31.5	41.55	63.44	98.63
3.....	5.45	8.7	14.37	18.75	27.64	33.1	45.40	69.84	106.30
3 1/2...	6.46	9.7	15.83	20.90	29.74	36.7	49.28	75.93	114.30
4.....	7.09	10.7	17.3	23.09	32.89	40.3	53.16	81.77	122.30
4 1/2...	7.7	11.7	18.76	25.27	34.98	43.0	57.04	87.61	130.30
5.....	8.3	12.7	20.2	27.50	36.01	47.3	61.90	93.45	138.30
5 1/2...	8.9	13.7	21.58	29.59	38.61	50.9	65.77	99.46	146.30
6.....	9.5	14.7	22.95	31.68	41.22	52.9	68.90	105.13	154.30
6 1/2...	10.2	15.7	24.42	33.9	43.82	56.5	72.77	111.14	162.30
7.....	10.8	16.7	25.9	35.73	46.42	60.7	76.71	117.15	170.30
7 1/2...	11.5	17.7	27.37	37.56	49.02	64.3	80.58	123.16	178.30
8.....	12.1	18.7	28.84	39.	51.64	67.9	84.45	129.17	186.30
9.....	13.4	20.8	31.8	43.18	56.84	75.1	92.19	141.19	202.30
10.....	14.6	22.9	34.75	47.36	62.04	82.3	99.94	153.21	218.30
11.....	15.8	24.9	37.7	51.6	67.24	89.5	107.69	165.23	234.30
12.....	17.	26.9	40.65	55.76	72.44	96.7	115.44	177.25	250.30
13.....	18.2	28.9	43.6	59.92	77.64	103.9	123.19	189.27	266.30
14.....	19.4	31.0	46.55	64.20	82.84	111.1	130.94	201.29	282.30
15.....	20.6	33.	49.5	68.36	88.04	118.3	138.69	213.31	298.30
16.....	21.8	35.	52.45	72.52	93.24	125.5	146.44	225.33	314.30
17.....	23.	37.	55.4	76.68	98.44	132.7	154.19	237.35	330.30
18.....	24.2	39.	58.35	80.84	103.64	139.9	161.94	249.37	346.30
19.....	25.4	41.	61.3	85.	108.83	147.1	169.69	261.39	362.30
20.....	26.6	43.	64.25	89.16	114.04	154.3	177.44	273.41	378.30
21.....	27.8	45.	67.20	93.32	119.20	161.5	185.19	285.43	394.30
22.....	29.	47.	70.15	97.48	124.44	168.7	192.94	297.45	410.30
23.....	30.2	49.	73.1	101.64	129.64	175.9	200.69	309.47	426.30
24.....	31.4	51.	76.05	105.80	134.80	183.1	208.44	321.49	442.30
25.....	32.6	53.	79.	109.96	140.04	190.3	216.19	333.51	458.30
26.....	33.8	55.	81.95	114.12	145.24	197.5	224.94	345.53	464.30
27.....	35.	57.	84.9	118.28	150.44	204.7	232.19	357.55	480.30
28.....	36.2	59.	87.8	122.44	155.64	211.9	240.44	369.57	496.30
29.....	37.4	61.	90.75	126.60	160.84	219.1	248.24	381.59	512.30
30.....	38.6	63.	93.7	130.76	166.04	226.3	254.94	393.61	528.30

WEIGHT PER 100 OF CUT THREAD CARRIAGE BOLTS WITH NUTS

Length, Inches	3/16 Lbs.	1/4 Lbs.	5/16 Lbs.	3/8 Lbs.	7/16 Lbs.	1/2 Lbs.
1/2.....	1.24	2.27	3.98	6.92	9.82	12.01
3/4.....	1.46	2.59	4.51	7.55	10.67	13.42
1.....	1.69	2.92	5.05	8.38	11.62	14.84
1 1/4.....	1.93	3.25	5.59	9.11	12.58	16.26
1 1/2.....	2.16	3.58	6.13	9.84	13.54	17.68
1 3/4.....	2.40	3.91	6.67	10.56	14.50	19.10
2.....	2.64	4.23	7.21	11.28	15.46	20.52
2 1/4.....	2.88	4.57	7.75	12.00	16.43	21.96
2 1/2.....	3.11	4.88	8.29	12.73	17.40	23.40
2 3/4.....	3.34	5.21	8.83	13.46	18.37	24.84
3.....	3.57	5.55	9.37	14.19	19.33	26.28
3 1/4.....	3.80	5.88	9.91	14.92	20.29	27.71
3 1/2.....	4.03	6.21	10.45	15.65	21.25	29.14
3 3/4.....	4.26	6.54	10.99	16.38	22.21	30.58
4.....	4.49	6.86	11.52	17.10	23.17	32.01
4 1/4.....	4.72	7.19	12.05	17.82	24.13	33.44
4 1/2.....	4.95	7.52	12.58	18.54	25.09	34.87
4 3/4.....	5.18	7.85	13.11	19.26	26.05	36.31
5.....	5.41	8.18	13.64	19.98	27.01	37.75
5 1/2.....	5.67	8.84	14.69	20.42	28.93	40.66
6.....	6.33	9.50	15.75	22.86	30.85	43.56
6 1/2.....	6.79	10.16	16.81	24.30	32.77	46.46
7.....	7.25	10.82	17.87	25.74	34.70	49.36
7 1/2.....	7.71	11.48	18.93	27.18	36.63	52.26
8.....	8.17	12.14	19.99	28.63	38.55	55.16
8 1/2.....	8.63	12.80	21.05	29.98	40.47	58.06
9.....	9.09	13.46	22.11	31.52	42.39	60.96
9 1/2.....	9.55	14.11	23.17	32.96	44.31	63.86
10.....	10.01	14.77	24.23	34.40	46.23	66.76
11.....	10.93	16.08	26.35	37.28	50.07	72.56
12.....	11.85	17.39	28.47	40.16	53.91	78.36

WEIGHT PER 100 OF NUTS

NUTS	.407	.803	1.65	2.86	4.18	4.98
------	------	------	------	------	------	------



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, U.S.A.

DIMENSIONS OF IRON SCREWS. APPROXIMATE.

This Page from Horstmann & Tousley's "Electrical Wiring and Construction Tables," 1907.

Trade Number	Diameter in Fractions	Nearest B. & S. Gauge	Greatest Length Obtainable
0.....	7/128	15	3/8
1.....	9/128	14	1/2
2.....	5/64	12	7/8
3.....	3/32	11	1 1/2
4.....	7/64	9	1 1/2
5.....	4/32	8	2 1/2
6.....	17/128	7	3
7.....	19/128	7	3
8.....	5/32	6	4
9.....	11/64	5	4
10.....	12/64	5	4
11.....	13/64	4	4
12.....	27/128	4	6
13.....	29/128	3	6
14.....	15/64	3	6
15.....	1/4	2	6
16.....	7/64	2	6
17.....	9/32	1	6
18.....	19/64	1	6

DIMENSIONS OF COMMON NAILS. APPROXIMATE.

Trade Number	Diameter in Fractions	Nearest B. & S. Gauge	Length in Inches	Number per Lb.
2d.....	9/128	13	1	875
3d.....	5/64	12	1 1/4	565
4d.....	7/64	10	1 1/2	315
5d.....	7/64	10	1 3/4	270
6d.....	7/64	9	2	180
7d.....	7/64	9	2 1/4	160
8d.....	17/128	8	2 1/2	105
9d.....	17/128	8	2 3/4	95
10d.....	19/128	7	3	70
12d.....	19/128	6	3 1/4	60
16d.....	5/32	6	3 1/2	50
20d.....	25/128	4	4	30
40d.....	15/64	3	5	15
60d.....	9/32	1	6	12

DIMENSIONS OF PORCELAIN KNOBS

Trade Number	Height	Diameter	Hole	Groove	Height of Wire
0.....	2 1/4	3	1 1/4	1	1/2
1.....	2	2 1/8	7/16	3/4	1 3/4
2.....	2	2	1/2	1/2	1
3.....	1 3/4	2	7/16	7/16	3/4
3 1/2.....	2	2	7/16	7/16	1
4.....	1 11/16	1 1/2	3/8	3/8	7/8
4 1/2.....	1 7/8	1 1/2	3/8	7/16	1
5.....	1 1/4	1	1/4	5/16	3/4
5 1/2.....	1 9/16	1	1/4	5/16	1
7.....	1 3/4	7/8	1/4	7/16	1 1/8
9.....	1 1/8	5/8	3/16	3/16	3/4
10 1/2.....	1 3/4	1 5/8	3/8	3/8	1

DIMENSIONS OF CLEATS

One-Wire Cleats—Duggan Cleat

No. 4 holds wires.....	16-8 B. & S.	No. 6 holds wires.....	000-300,000 C. M.
No. 7 holds wires.....	6-2 B. & S.	No. 8 holds wires.....	400,000-800,000 C. M.
No. 5 holds wires.....	2-00	No. 9 holds wires.....	900,000-1,200,000 C. M.

Brunt Cleat

Stand Number	Width	Length	Groove	
328	3/4	2	3/8	holds wires.....16-5 B. & S.
329	1	2 1/4	1/2	holds wires.....8-3
331	13/16	2 3/4	13/16	holds wires.....3-00
330	1 1/8	2 1/2	1/2	holds wires.....4-1
332	1 1/4	2 7/8	15/16	holds wires.....0-0000

Two and Three-Wire Cleats—Brunt Cleat

No. 334	2-wire holds wires.....	16- 8 B. & S.	No. 337	3-wire holds wires.....	16- 8 B. & S.
---------	-------------------------	---------------	---------	-------------------------	---------------

Duggan

No. 3	2-wire holds wires.....	16- 8 B. & S.	No. 1	3-wire holds wires.....	16- 8 B. & S.
No. 2	2-wire holds wires.....	6-00 B. & S.			

Pass & Seymour

No. A-3	2-wire holds wires.....	14-12 B. & S.	No. A-43	3-wire holds wires.....	14-12 B. & S.
No. 3	2-wire holds wires.....	14- 6 B. & S.	No. 43	3-wire holds wires.....	14- 6 B. & S.

DIMENSIONS OF FINE NAILS. APPROXIMATE.

Trade Number	Diameter in Fractions	Nearest B. & S. Gauge	Length in Inches	Number per Lb.
2d.....	7/128	15	1	1350
3d.....	9/128	13	1 1/3	770
4d.....	5/64	12	1 1/2	470

USEFUL DATA

CEMENT

Cement Mortar for filling spaces between ducts is made of one part hydraulic cement and two parts sand.

Concrete for enclosing run of conduits is made of one part hydraulic cement, two parts sand and five parts screened gravel, broken stone or broken brick. The gravel, stone or brick shall not exceed one inch in diameter. The cement and sand to be thoroughly mixed dry, water added to make soft mortar, gravel, stone or brick thoroughly wet down, added to mortar and thoroughly mixed with it.

BLOCKS AND TACKLE

In any combination of pulleys where one continuous rope is used, a load on the free end (or fall line) will balance a weight on the movable block as many times as great as the load on the free end as there are parts of the rope supporting the load—not counting the fall line, as witness the fact that in a pair of 3 sheave blocks, if the movable block is raised one foot, there will be one foot of slack in each one of the 6 parts of the rope, and therefore 6 feet of rope in the fall line if slack is pulled out. (If the fall line works out of the movable block it should also be counted.)

STEEL STRAND—GALVANIZED

(John A. Roebling Sons Co.'s.)

Diameter in 32nds of an Inch	Weights per 100 Feet Pounds	Ultimate Strength Pounds				
		Ordinary	Special	S. Martin Steel	High Strength	Extra High Strength
16	51	8,320	16,640	14,000	18,000	27,000
15	48	7,500	15,000	.....	.....	.....
14	37	6,000	12,000	9,000	15,000	22,500
12	30	4,700	9,400	6,800	11,500	17,250
10	21	3,300	6,600	4,860	8,100	12,100
9	18	2,600	5,200	4,380	7,300	10,900
8	11½	1,750	3,500	3,050	5,100	7,600
7	8¾	1,300	2,600	.....	.....	.....
6	6½	1,000	2,000	2,000	3,300	4,900
5	4½	700	1,400	.....	.....	.....

SIZE OF CABLE MESSENGERS

No. 32, B. & S. Gauge. W. C. Cable.		No. 10, B. & S. Gauge. W. E. Cable.	
No. of Pairs	Size of Messenger	No. of Pairs	Size of Messenger
5 to 20	No. 6 Stl. Wire	5 to 20	No. 6 Stl. Wire
25 to 100	9/32" Stl. Strand	25 to 75	9/32" Stl. Strand
125 to 400	¾" Stl. Strand	100 to 250	¾" Stl. Strand

Loaded Messenger should not have over one inch sag per 10 feet of length.

In spans of 100 feet or less, Messenger shall have not more nor less than 1½ inches of sag for cables from 100 to 400 pairs. For smaller cables Messenger may be stretched somewhat more tightly.

WIND PRESSURES

Velocity.....	37	53	65	75	83	91	105	119	130
Pounds per square foot.	5	10	15	20	25	30	40	50	60

The pressures above given are such as would be exerted against a flat surface set perpendicularly to the direction of the wind. For a cylindrical surface like a pole or wire, the effective pressure is two-thirds of what it would be for a square surface of the same area as the cylinder. It is considered that an allowance of from 20 to 30 pounds per square foot of area for pole lines is ample. The above table was calculated from Professor Langley's formula, $P = .0036 V^2$, in which P is the pressure per square foot of surface in pounds, and V the velocity of the wind.

CARD RECORD FOR CONSUMER'S METER AND CONNECTED LOAD

A good form for keeping a record of the consumer's meter and the connected load is shown in the accompanying cut. These cards are made out when the order is written to connect the customer, and filed alphabetically and numerically according to street address. They give complete and detailed information regarding each connection. It will be found preferable to have a separate file for customers that have been disconnected at the outlets, and the meter removed. These cards should be destroyed when the service taps have been removed from the building.

FORM 693

SIZE AND STYLE		CONST.	NUMBER		OUT'S	CONT'D	DISC.	ORD. DISC.	PART. DISC.	C. OF S.	ADD'L SERVICE	LIGHT COUNTS			METER CHANGES		
Light																	
CARBON AND GEM	WATTS	TUNGSTENS															
		NO.	WATTS	NO.	WATTS	H.P.		VOLTS		A.C. D.C.		NATURE OF PREMISES					
					500	H.P.		VOLTS		A.C. D.C.		AMP. STERO.		VOLTS		A.C. D.C.	
	20		5			H.P.		VOLTS		A.C. D.C.		AMP. SPOT		VOLTS		A.C. D.C.	
	25		25														
	30		40	NERNST		DESK FAN		VOLTS		A.C. D.C.		AMP. RECT. 230 V. NO.					
	40		60	NO.	GL.	C'L'G. FAN		VOLTS		A.C. D.C.							
	50		100			IRON		WATTS				TOTAL Kw.					
	60		150	ARCS													
	100		250	NO.	STYLE	CONNECTED TO											
			400			REMARKS											
TOTAL NO. SOCKETS				TOTAL NO. EMPTY													
SIZE AND STYLE		CONST.	NUMBER		OUT'S	CONT'D	DISC.	ORD. DISC.	PART. DISC.	C. OF S.	ADD'L SERVICE	LIGHT COUNTS			METER CHANGES		
Power																	
H.P.		VOLTS		A.C. D.C. 3 PH.								CEILING FAN		VOLTS		A.C. D.C.	
H.P.		VOLTS		A.C. D.C. 3 PH.								DESK FAN		VOLTS		A.C. D.C.	
H.P.		VOLTS		A.C. D.C. 3 PH.								AMP. RECT. 230 V. NO.					
H.P.		VOLTS		A.C. D.C. 3 PH.													
H.P.		VOLTS		A.C. D.C. 3 PH.								TOTAL Kw.					
H.P.		VOLTS		A.C. D.C. 3 PH.		CONNECTED TO.											
H.P.		VOLTS		A.C. D.C. 3 PH.		REMARKS.											
H.P.		VOLTS		A.C. D.C. 3 PH.													

BLANK ELECTRIC LIGHT & POWER CO.

.....191.....
 Wires on Poles of.....Co.
 on.....side of.....

REMARKS: Ft. Pole

4	3	2	1	1	2	3	4	Occupied by
				1				
				2				
				3				
				4				
				5				
				6				
				7				
				8				
				9				
				10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				

CARD RECORD OF POLES AND POLE SPACE

Cards should be made out for every pole owned by the company, and for every foreign pole on which the company has space. A good form, No. 694, is shown on page 195, which can be used for both foreign poles and for the company's poles. These cards should be filed alphabetically according to street numbers.

When a report comes to the office that a pole has been set, the card is made out, and all the information concerning the pole is entered on the card. This card is kept up to date by entering the space granted foreign companies on the card, the date when granted, also when canceled.

When keeping a record of the space granted to the company by foreign companies, the same card form may be used, and the records kept in a similar way. When a company adopts a system of this kind, when poles are

already up and space occupied, it is best not to rely on records that may be far from correct, but to send out inspectors to ascertain the exact conditions. The inspector is given a pad, form No. 695, shown below. This may be used either for compiling a record of the company's own poles, or the space which it occupies on foreign poles. The inspector patrols the lines, showing on his pad just the space occupied. Cable space, cable heads, lateral pipes, etc., may be drawn in by him and noted under remarks. The height of poles does not have to be estimated, for the inspector can tell the exact height if equipped with a Matthews Teletheight.

Upon his return to the office he gives his report to the record clerk, who makes out a card entering the data, which the inspector has furnished him. If the space does not check out with the old records, the foreign companies should be asked to apply for the new space, and to cancel the old.

CARD RECORD OF POLES AND POLE SPACES

FORM 694

Co. pole. pole of

ft. pole

	Company	Granted	Canceled	Side	Remarks	Company	Granted	Canceled	Side	Remarks
1										
2										
3										
4										
5			By		For \$					
6			191		191					
7										
8										
9										
10	Permit No.									
11										
12										
13	Kind of Pole				Date		Permit No.			
14										
15	Erected						City Notice No.			
16	Setting									
17	Sold to									
18										

NOTE THE ABOVE APPEARS ON BACK OF CARD

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.



MAP RECORD OF OVERHEAD SECONDARY LINES

In all cities and nearly all towns maps showing all buildings drawn to a scale of about 50 feet to 1 inch may be secured, bound in large volumes. They are compiled by the Sanborn Map Company, 11 Broadway, New York City, chiefly for the use of insurance companies. These companies sell the maps, and about four times a year, for a small charge, send out girls to make any alteration in the maps that may be necessary, such as new buildings, buildings altered, torn down, etc. Tracings may be made from these maps on tracing paper, preferably a separate tracing for each block, and the tracing transferred to a bristol board card about 1'x1½' for a permanent record.

Most city blocks are numbered, and the card is best filed by the city block number. The tracing is then given to an inspector, who goes out to a certain block and shows the location of poles of all companies on the map, with distinctive symbols as shown on the drawing on page 197. He shows the number of wires (that is whether it is a two or three-wire secondary), also the position of the secondary on the poles; for instance, fourth gain, pins 1, 2, 3 West. He also shows all transformers connected to the secondary. If the secondary is a three-wire secondary and customers connected two wire to one side, the side which they are connected to should also be shown. When the inspector gets back to the office a clerk should take the tracing and draw in the poles and secondary lines as he has shown them on the corresponding card map, which has been filed. He should also look up the foreman's report on this particular work, as a check upon the inspector and to obtain the size of wire used. He then takes the card showing the connected load of the customer and enters it in the corresponding house on the map; he should also show the size of the transformer on the secondary.

When the load in each building is entered he should total the load on the secondary, and if it should be a three-wire secondary, the load on each side. This may be done either by reducing the load to watts, or preferably to some equivalent, such as 16 C. P. lamps. This total load is then entered on the map as shown on the drawing.

These maps are kept always up-to-date by clerks from the reports of overhead and installation departments; for instance, a report comes in that three number six secondary wires are extended from the fourth to the fifth poles West of F Street, the alley South of 23d Street, fourth gain pins 1, 2, 3 North. The clerk then draws in the secondary as the foreman says the work has been done. Reports of service connections or an increase in the connected loads, are taken care of in a similar way, the new load being added or subtracted both to the load in the house and to the total connected load.

Any one looking at such a map, may see at a glance the exact conditions, can see to which side of the secondary any customer should be connected, and from what pole the tap should be strung, when a transformer is overloaded, etc.

Proposed extensions of the secondary lines may be dotted in, and drawn in full when the work is done.

MAP REPORT OF OVERHEAD PRIMARY LINES

Maps drawn to scale of about 400 feet to 1 inch, each map about 4 feet square, are probably the most satisfactory for keeping a record of primary lines. These maps should be put on a very substantial cardboard, the edges bound and handles put on, and kept in a suitable case.

Feeders should bear a name or number, that not only distinguishes that feeder, but gives the location of the cable end, the pole where the feeder comes from the underground. This may be done in the following way: Supposing the terminal pole was on the corner of two streets, one of which was 1500 North and the other 2700 West, the name or number of the feeder ending on this pole would be N. 1527 W. If the street was 1400 South and 3600 West, it would be S. 1436 W. If the terminal pole should be at an alley, "A" may be put before the direction letter. This system may be altered to suit the street numbering system in any city. Feeders should be shown in red ink to distinguish them from the mains branching off from them. If the system should be a four-wire three phase system and the single phase taps are taken from the three phase primary, the number of wires and size should be marked as shown on the sketch. Also the phase to which the single phase main is connected should be shown. Lightning arresters and switches should be shown where they are installed. If the switch should be a Matthews' Fuse Switch, the size of the fuse should be indicated. If the tap is cut in with the old-style primary fuse block, or cut out, the size of the fuse in this should be shown also.

Proposed lines may be dotted in in pencil, and drawn in solid in ink when they are constructed.

ESTIMATING THE COST OF LINE EXTENSION

When the sales department of an electric light and power company has secured a prospect, or a man has applied for electric light or power service, it is first necessary to find out whether the service is available at that location.

The department in charge of the service maps refer to them, and if no extension of the line is necessary, they advise the sales department that the prospective customer can be connected. When an extension of either the primary or secondary lines is necessary, the sales department is told the approximate length of the extension required, and an inspector is sent out to determine the exact cost of supplying service at that location.

The inspector should not only be familiar with line construction work, but should know the location of the existing lines, the points from which the mains feed, and the district that each feeder should supply. He should first determine the point from which the extension should be made and the best route to be taken. This would not necessarily be the shortest route, for he should choose such a route that the line will be of permanent nature, and take care of future business.

In cities, poles should be set on lot lines where this is possible, and always at points where they will not block gates, or windows of sheds, or other buildings, etc. When it is necessary to make a turn in pole lines, the line should always be built, so that both leads may be properly guyed. In making turns in T alleys it is very often difficult to secure this, and it is here that Matthews' Guy Anchors can be used to a great advantage. Property owners are very likely to object to the digging of a hole in their yards for a dead-man or any of the patented anchors that must be inserted in a hole. They rarely object to a Matthews' Guy Anchor, because it is screwed into the ground without the slightest injury to their lawns.

When it is necessary to set poles, the pole line should be laid out first. The simplest way is to make a rough sketch indicating by cross marks, the poles to be set, and showing the height of and the distance between each pole. It is often very difficult to determine the exact heights of poles necessary to properly clear other pole lines, trees, etc., therefore it can readily be seen how important it is that the inspector does not make mistakes. He can count the steps and gains of poles to be crossed and thus estimate the height of poles necessary with more or less accuracy, but when the proposed line must go over other obstructions, such as trees, bridges, etc., he must simply guess at it, unless he is provided with a Matthews' Teleheight. (See pages 28 and 29.)

When the poles have been spotted on his plat, any special material required should be shown opposite the mark indicating the pole where it is to be installed. When existing poles are to be used, the method is the same, except of course the height of the poles need not be shown.

The actual estimating of the material necessary is then very simple. The total distance multiplied by the number of wires to be strung with an allowance for sag, dead-ending, etc., will be the amount of wire required. When the cross arms, spreaders, etc., have been counted, the number of insulators and the amount of tie wire necessary can be readily determined.

The inspector should allow a Matthews' Fuse Switch to be cut in on each "hot wire" whenever a primary tap is taken from another main or feeder. Lightning arresters should be installed about every thousand feet. If ground pipes are used and the earth in that locality is somewhat dry, there is danger of the grounds baking out, and secondary lines should be grounded about every five poles.

In order to estimate the labor correctly, the inspector must take into consideration all of the circumstances peculiar to that particular job; the number of guys, dead-ends, turns, right angle work, etc. In connection with the dead-ends and turns, which take more time than other parts of construction work, Matthews' Cable Clamps cut down the labor to a minimum. Where wires are smaller than 000 use Matthews' 2-Bolt Clamps. (See pages 10 and 11.)

When the material has been totaled up and entered on the line slip, it is turned into the office, and the cost of the labor and material is entered on the slip.

The sales department is given a plat of the proposed line and the cost of the extension, and the salesman canvases the territory to see if the prospects justify the expense at the present time. When the extension is to be made, the line slips are given to a stenographer, who copies them onto the order form.

If permits are necessary to do the work, the line slips are turned over to the permit clerk and permits are applied for. When the permits have been received, they are attached to the orders and line slips, and given to the foreman who has to do the work. His requisition for the material needed on the job can be made out from the line slip.

FACE
FORM 1. BLUE

BLANK ELECTRIC LIGHT & POWER COMPANY
LINE EXTENSION LINE SLIP

L. S. NO. _____ DATE _____ 191 _____

LOCATION _____

EXTENSION FOR _____

TOTAL DISTANCE FROM PRESENT LINE _____ FT.

IN ADDITION TO EXTENSION FOR _____

NUMBER UNION POLES TO BE SET _____

NUMBER _____ POLES TO BE SET _____

PRIMARY EXT. OF _____ FT; SECONDARY EXT. OF _____ FT.

MATERIAL

COST

_____ FT. NO. _____ PRIMARY WIRE

_____ FT. NO. _____ SECONDARY WIRE

_____ FT. NO. _____ WIRE

_____ FT. _____ INCH GUY WIRE

_____ MATTHEWS PRISSECTIONS _____ PIN SEC. ARMS

_____ MATTHEWS DEADEND EYE _____ PIN PRI. ARMS

_____ MATTHEWS FUSE SWITCHES _____ LIGHTNING ARRESTERS

_____ GROUND PIPE _____ MATTHEWS CABLE CLAMPS

_____ MATTHEWS 2 BOLT OR BOLTLESS CLAMPS _____ PINS

_____ POLE BRACKETS _____ SHIMS

_____ MATTHEWS GUY ANCHORS _____ SPREADERS

_____ KNEE BRACES _____ HEEL BRACES

_____ INSULATORS _____ INSULATORS

_____ FT. RUBBER HOSE _____ CIRCULAR LOOM

MATERIAL COST

LABOR _____ MEN _____ HOURS

TOTAL COST

ACCOUNT NO. _____ POLE COST

GENERAL FOREMAN _____ GRAND TOTAL

BACK
FORM 1 BLUE

PRESENT TERMINUS _____ POLE _____ OF

_____ SIDE OF ALLEY _____ OF

_____ GAIN PINS

ROUTE OF EXTENSION, _____

PROSPECTS _____

APPLY FOR _____ SPACE _____

APPLIED FOR

DATE _____ 191 _____

INSPECTOR

Actual size, $8\frac{1}{8}$ inches

199

Actual size, $3\frac{5}{8}$ inches

Actual size, $3\frac{5}{8}$ inches

OTHER SIDE CROSS RULED
FORM 2. ORANGE

BLANK ELECTRIC LIGHT & POWER COMPANY
POLE LINE SLIP

L. S. NO. _____ DATE _____ 191 _____

LOCATION _____

EXTENSION FOR _____

MATERIAL	COST
FT. POLES	
FT. POLES	
FT. POLES	
FT. STUBS	
POLE STEPS	
SAND	
ROCK	
CEMENT	
STORE-ROOM EXPENSE	
HAULING	
MATTHEWS POLERECTOR	
LABOR _____ MEN _____ HOURS _____	
MATERIAL COST	
TOTAL COST	

REMARKS _____

ACCOUNT NO. _____ DATE _____ 191 _____

GENERAL FOREMAN _____ INSPECTOR _____

OTHER SIDE BLANK
FORM 3. LEMON

BLANK ELECTRIC LIGHT & POWER COMPANY
TRANSFORMER LINE SLIP

L. S. NO. _____ DATE _____ 191 _____

LOCATION _____

FOR _____

FT. NO. _____	PRIMARY WIRE
FT. NO. _____	SECONDARY WIRE
FT. NO. _____	GROUND WIRE
FT. NO. _____	LEAD COVERED CABLE
MATTHEWS PRISECTIONS	MATTHEWS FUSE SWITCHES
CROSS ARMS	PRI. FUSE BLOCKS
HALF CROSS ARMS	INSULATORS
OAK ARMS	HEEL BRACES
FT. CIRCULAR LOOM	SLAB BRACES
GROUND PIPE	FT. HOSE
MOULDING	SEC. FUSE BLOCKS
	MATERIAL COST
LABOR _____ MEN _____ HOURS _____	
	TOTAL COST

INSTALL _____ KW THREE SINGLE PHASE TRANSFORMER ON (BODY OF) _____

POLE _____ OF _____

ON _____ SIDE _____

OF ALLEY _____ OF _____ GAINS _____

CONNECT TWO THREE WIRE 115 230 VOLTS TO TWO THREE WIRE SECONDARY

APPLY FOR _____ GAIN ON ABOVE POLE FOR TRANSFORMER.

REMARKS _____

ACCOUNT NO. _____ DATE _____ 191 _____

GENERAL FOREMAN _____ INSPECTOR _____

Actual size, $3\frac{3}{8}$ inches

Actual size, $3\frac{3}{8}$ inches

Actual size, $8\frac{1}{2}$ inches
200

FORM 4 WHITE
BLANK ELECTRIC LIGHT & POWER COMPANY
 SERVICE CONNECTION LINE SLIP

L. S. NO. _____ DATE _____ 191__

ADDRESS _____

NAME _____

LOAD _____ MATERIAL _____ WANTED _____ COST _____

FT NO. _____ WIRE _____	FT NO. _____ WIRE _____
FT CIRCULAR LOOM _____	MATTHEWS CABLE CLAMPS _____
CROSS ARMS _____	CROSS ARMS _____
POLE BRACKETS _____	3 POINT SPREADER _____
WALL BRACKETS _____	BRACE BRACKETS _____
INSULATORS _____	INSULATORS _____

LABOR _____ MEN _____	MATERIAL COST _____
_____ HOURS _____	_____
TOTAL COST _____	_____

DISTANCE FROM _____ ESTABLISHED PROJECTED LINE _____ FT

OUTLETS _____ TWO WIRE LOCATED ON _____ SIDE OF BLDG.

SHOULD WIRE TO _____

STRING _____ NO. _____ SECONDARY WIRES FROM _____

_____ POLE _____ OF _____

_____ ON _____ SIDE _____

OF ALLEY _____ OF _____

_____ GAIN, PINS _____

CONNECT TWO WIRE 115 VOLTS TO TWO WIRE SEC
 THREE 230 THREE

APPLY FOR _____ GAIN ON _____

_____ DATE _____ 191__

GENERAL FOREMAN _____ INSPECTOR _____

Actual size, 3 5/8 inches.

Actual size, 8 1/2 inches.

SAFETY FIRST

The above slogan has gone all over the country. All public service corporations are doing everything they can to educate their employes and their public to its full meaning. For the convenience of our readers we give below the page numbers in this Handbook where Safety First Warnings and Suggestions may be found:

35, 53, 67 (letter No. 24), 72, line 5, paragraph 1; 95, paragraphs 3, 4 and 5; 99, last paragraph; 100, 102, 103, letters Nos. 1 and 4; 104, letters Nos. 7, 9 and 13; 126, letter from Cliff Distributing Co.; 130, 132, newspaper clipping; 137, first four paragraphs; 144, second paragraph; 149, "Moving and Changing Guys Under Strain;" 157, Diagram 2, and 202 to 206.

W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS, MO. U.S.A.



RULES FOR RESUSCITATION FROM ELECTRIC SHOCK

Reprinted by Permission of the National Electric Light Association

Recommended by Commission on Resuscitation from Electric Shock

Representing

The American Medical Association

The National Electric Light Association

The American Institute of Electrical Engineers

SUPERINTENDENTS, FOREMEN AND OTHERS HAVING CHARGE OF MEN, ARE ADVISED TO GIVE PRACTICAL INSTRUCTIONS AND DEMONSTRATIONS ON THE USE OF THESE RULES TO ALL OLD AND NEW EMPLOYEES.

PHYSICIANS WHO MAY BE CALLED UPON IN CASES OF SHOCK SHOULD BE GIVEN COPIES OF THESE INSTRUCTIONS, AND WHERE PRACTICABLE, PLACED IN COMMUNICATION WITH THE PHYSICIAN OF THE ELECTRICAL COMPANY.

The prone-pressure method of artificial respiration described in these rules (Section III) is equally applicable, after clearing the mouth and throat of froth, to resuscitation of the apparently drowned, and also to cases of suspended respiration due to inhalation of gas or to other causes.

COMMISSION ON RESUSCITATION FROM ELECTRIC SHOCK

- DR. W. B. CANNON, Chairman,
Professor of Physiology, Harvard University.
- DR. GEORGE W. CRILE,
Professor of Surgery, Western Reserve University.
- DR. YANDELL HENDERSON,
Professor of Physiology, Yale University.
- DR. S. J. MELTZER,
Head of Department of Physiology and Pharmacology,
Rockefeller Institute for Medical Research.
- DR. EDW. ANTHONY SPITZKA,
Director and Professor of General Anatomy, Daniel Baugh
Institute of Anatomy, Jefferson Medical College.
- MR. W. C. L. EGLIN,
Past President, National Electric Light Association.
- DR. A. E. KENNELLY,
Professor of Electrical Engineering, Harvard University.
- DR. ELIHU THOMSON,
Electrician, General Electric Company.
- MR. W. D. WEAVER, Secretary,
Former Editor, Electrical World.



W.N. MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.

TREATMENT FOR ELECTRIC SHOCK

An accidental electric shock usually does not kill at once, but may only stun the victim and for a while stop his breathing. The shock is not likely to be immediately fatal, because:

- (a) The conductors may make only a brief and imperfect contact with the body.
- (b) The skin, unless it is wet, offers high resistance to the current.

Hope of restoring the victim lies in prompt and continued use of artificial respiration. The reasons for this statement are:

- (a) The body continuously depends on an exchange of air, as shown by the fact that we must breathe in and out about fifteen times a minute.
- (b) If the body is not thus repeatedly supplied with air, suffocation occurs.
- (c) Persons whose breathing has been stopped by electric shock have been reported restored after artificial respiration has been continued for approximately two hours.

The Schäfer, or "prone pressure," method of artificial respiration, slightly modified, is illustrated and described in the following resuscitation rules. The advantages of this method are:

- (a) Easy performance; little muscular exertion is required.
- (b) Larger ventilation of the lungs than by the supine method.
- (c) Simplicity; the operator makes no complex motions and readily learns the method on first trial.
- (d) No trouble from the tongue falling back into the air passage.
- (e) No risk of injury to the liver or ribs if the method is executed with proper care.

Aid can be rendered best by one who has studied the rules and has learned them by practice on a volunteer subject.

INSTRUCTIONS FOR RESUSCITATION

Follow These Instructions Even if Victim Appears Dead

I.—BREAK THE CIRCUIT IMMEDIATELY

1. With a single quick motion separate the victim from the live conductor. In so doing avoid receiving a shock yourself. Many have, by their carelessness, received injury in trying to disconnect victims of shock from live conductors.

Observe the Following Precautions

(a) Use a dry coat, a dry rope, a dry stick or board, or any other *dry non-conductor* to move either the victim or the wire, so as to break the electrical contact. Beware of using metal or any moist material. The victim's loose clothing, if dry, may be used to pull him away; do not touch the soles or heels of his shoes while he remains in contact—the nails are dangerous.

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(b) If the body must be touched by your hands, be sure to cover them with rubber gloves, mackintosh, rubber sheeting or dry cloth; or stand on a dry board or on some other dry insulating surface. If possible, use only *one* hand.

If the victim is conducting the current to ground, and is convulsively clutching the live conductor, it may be easier to shut off the current by lifting him than by leaving him on the ground and trying to break his grasp.

2. Open the nearest switch, if that is the quickest way to break the circuit.

3. If necessary to cut a live wire, use an ax or a hatchet with a dry wooden handle, or properly insulated pliers.

II.—SEND FOR THE NEAREST DOCTOR

This should be done without a moment's delay, as soon as the accident occurs, and while the victim is being removed from the conductor.

The Doctors entered on page 202 are recommended.

III.—ATTEND INSTANTLY TO VICTIM'S BREATHING

(1) As soon as the victim is clear of the live conductor, quickly feel with your finger in his mouth and throat and remove any foreign body (tobacco, false teeth, etc.). Then begin artificial respiration at once. Do not stop to loosen the patient's clothing; *every moment of delay is serious.*

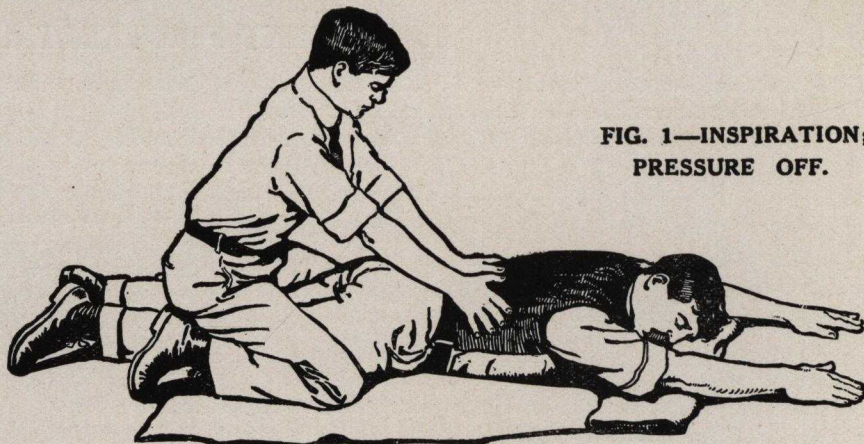


FIG. 1—INSPIRATION;
PRESSURE OFF.

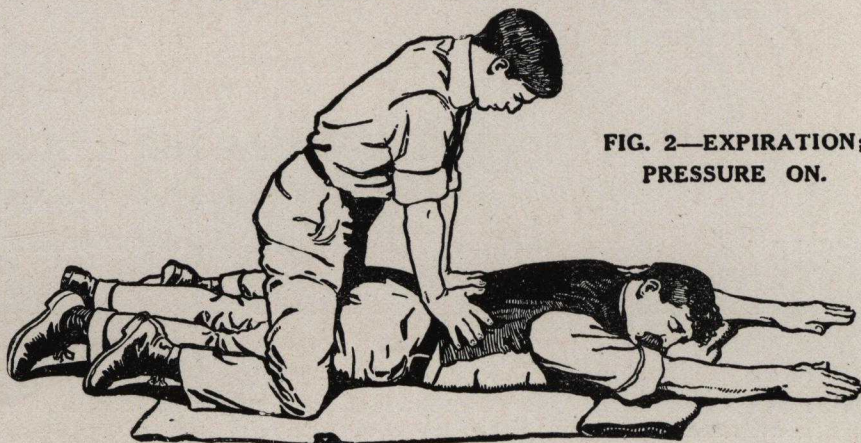


FIG. 2—EXPIRATION;
PRESSURE ON.

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(2) Lay the subject on his belly, with arms extended as straight forward as possible, and with face to one side, so that the nose and mouth are free for breathing (see Figure 1). Let an assistant draw forward the subjects' tongue.

If possible, avoid so laying the subject that any burned places are pressed upon.

Do not permit bystanders to crowd about and shut off fresh air.

(3) Kneel straddling the subject's thighs and facing his head; put the palms of your hands on the loins (on the muscles of the small of the back), with thumbs nearly touching each other, and with fingers spread over the lowest ribs (see Figure 1).

(4) With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the subject (see Figure 2). This operation, which should take from two to three seconds, *must not be violent*—internal organs may be injured. The lower part of the chest and also the abdomen are thus compressed, and air is forced out of the lungs.

(5) Now *immediately* swing backward so as to remove the pressure, but leave your hands in place, thus returning to the position shown in Figure 1. Through their elasticity, the chest walls expand and the lungs are thus supplied with fresh air.

(6) After two seconds swing forward again. Thus repeat deliberately twelve to fifteen times a minute the double movement of compression and release—a complete respiration in four or five seconds. If a watch or a clock is not visible, follow the natural rate of your own deep breathing—swinging forward with each expiration, and backward with each inspiration.

While this is being done, an assistant should loosen any tight clothing about the subject's neck, chest or waist.

(7) Continue artificial respiration (if necessary, two hours or longer), *without interruption*, until natural breathing is restored, or until a physician arrives. Even after natural breathing begins, carefully watch that it continues. If it stops, start artificial respiration again.

During the period of operation, keep the subject warm by applying a proper covering and by laying beside his body bottles or rubber bags filled with *warm* (not hot) water. The attention to keeping the subject warm should be given by an assistant or assistants.

(8) *Do not give any liquids whatever by mouth until the subject is fully conscious.*

FIRST CARE OF BURNS

When natural respiration has been restored, burns, if serious, should be attended to until a doctor comes.

A raw or blistered surface should be protected from the air. If clothing sticks, do not peel it off—cut around it. The adherent cloth, or a dressing of cotton or other soft material applied to the burned surface, should be saturated with picric acid (0.5 per cent). If this is not at hand, use a solution of baking soda (one teaspoonful to a pint of water), or the wound may be coated with a paste of flour and water. Or it may be protected with a heavy oil, such as machine oil, transformer oil, vaseline, linseed, carron or olive oil. Cover the dressing with cotton, gauze, lint, clean waste, clean handkerchiefs, or other soft cloth, held lightly in place by a bandage.

The same coverings should be lightly bandaged over a dry, charred burn, but without wetting the burned region or applying oil to it.

Do not open blisters.

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DISTRIBUTION

By John L. Fay.

Taken by permission from *Union Electric Bulletin*, September, 1913, issue.

The distribution system of a central station is somewhat similar to the blood vessel relations to the heart of the human system, except that it is a system of cables, wires and other distributing means to carry electrical energy throughout the system from the main source of supply. Any interruption of this means of carrying energy, means a congestion of the system which reacts back on the entire system. It then becomes necessary to call in the doctor (Trouble Department), who diagnoses the case and recommends relief through the proper department responsible for the maintenance of a healthy system.

Frank statements of facts to the public about connections to the distribution system will assist greatly in preventing disorders in the system, to occur, such as:

A maximum demand of 750 watts is permitted on two-wire, 115 volt A. C. or D. C. circuits, or the maximum energy a 5 Amp. two-wire, 115 volt meter will carry. Any connection requiring more than a 5 Amp., two-wire, 115 volt meter, must be wired for three-wire distribution, excepting old residences, which were wired two-wire before three-wire systems were established here.

All new residences and commercial installations are required to be wired three-wire when two or more circuits are required by fire prevention rules, even though connections be made to one side of our three-wire system. This is for the purpose of avoiding difficulties with consumer when additional service such as household appliances and larger lighting units are connected that would require a three-wire system.

The maximum unbalanced energy permitted on a three-wire, 115/230 volt A. C. or D. C. main is 750 watts. For example: If a consumer having three 600-watt circuits, two circuits are permitted on one side and a third circuit on the other side, making an unbalance of one circuit or 600 watts.

This general rule applies to small installations, such as small stores, shops, saloons, groceries, bakeries, etc., where there would be from three to five circuits and the unbalanced energy may vary from 0" to maximum full load on one side. In larger commercial and office building installations, there may be an equal connected load and an equal number of circuits on each side of a three-wire system, while the unbalanced energy will have a wide variation.

The balancing and regulation on three-wire mains, both A. C. and D. C. are satisfactory under above regulations and conditions.

Heating and cooking devices are limited to 750 watts per unit, and when two or more units of this size are connected, a three-wire connection is required. Picture shows on A. C. lines are supplied with 115-volt, two-wire service when stereopticon lamp operates on a rheostat, but when operating on mercury arc rectifier, auto transformer, or similar apparatus, same should be 230 volts, while lighting service should be balanced for three-wire distribution.

On 115/230 volt, D. C., three-wire systems, picture shows are permitted to operate stereopticon arc on one side of system, and with a part or all of lighting service, etc., on the opposite side.

It is a general rule for both A. C. and D. C. systems to connect motors of one-half horsepower capacity or over, 230 volts (our company permits D. C. motors of under one horsepower to operate on our lines at 115 volts), with exceptions of one-quarter horsepower and one-half horsepower, A. C. motors operating meat grinders, coffee mills and apparatus of similar character, which require a large starting current, should be 230 volts, or, if 115 volt, operate on auto transformer with primary connected 230 volt.

A number of 115-volt motors of this class are now connected to our lines, which causes poor pressure regulation and, of necessity, poor light complaints.

Picture shows on A. C. systems should always be supplied from individual transformers. Experience teaches us that this is the most feasible method of connection to avoid complaints from light consumers connected to the same three-wire secondary, even though stereopticon arc is operating on same transforming device with primary connected 230 volt.

A GOOD-WILL BUILDER

The Public is Entitled to Courteous Treatment and to the Best Possible Service

Courtesy is the most valuable asset that an employe of this Company can possess. The best efforts of the Company to please its patrons are sometimes offset by the thoughtlessness of an employe who may fail to remember that any act of his which develops ill-feeling reacts upon the Company and upon his fellow employes.

TO OUR EMPLOYEES

Courtesy is the outward expression of breeding and character. Don't forget that you are in the service of the public as well as of the Company. Never attempt to take advantage of a patron. The Company wants no revenue it does not earn. This is not a "soulless corporation," and the conduct of each individual employe should so demonstrate.

TO THE PUBLIC

Please do us the favor of selecting our office as the proper place to register complaints.

We are ready and anxious to investigate any "kick."

No individual or corporation can always be perfect. We invite your help and ask your co-operation in bettering our service.

The Trinidad Electric Transmission, Railway & Gas Co.

PUT A SLIP LIKE THIS IN WITH YOUR MONTHLY BILLS AND PAY ENVELOPES,
THEN SEE THAT ALL OF YOUR PEOPLE LIVE UP TO IT.

W.N.MATTHEWS AND BROTHER, INC. ST. LOUIS U.S.A.
FOURTH CITY



\$25.00 PRIZE PROPOSITION

THERE is always room for improvement. Possibly you can suggest a practical improvement to some of the Matthews' Money-Saving Specialties, described on pages 6 to 40. Or, possibly you can suggest some new field for their sale.

¶ For any suggestion that is adopted, we will send to the author a New York draft for \$25.00.

¶ If you have an invention that is either patented or that is new and useful, or therefore patentable, we will be glad to consider it either with the idea of purchasing the invention outright or making an agreement to manufacture and sell the articles on a royalty basis.

¶ We particularly want patented or patentable articles that can be sold to manufacturing plants. Something that will interest the men who would be interested in Matthews' Holdfast Lamp Guards, or Matthews' Scale Knockers.

¶ If you have a patent or a patentable idea write to us for details of our method of handling such matters; how to get the best protection for yourself; why it is important to know all about the qualifications of your patent attorney, etc.



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